# Advantage Counterplans – Nuclear Power

## Testing CP

### 1NC – Testing CP

#### Countries should authorize the World Association of Nuclear Operators and the Institute of Nuclear Power Operators to run nuclear power plants as test facilities for new nuclear technologies when they are scheduled to close.

#### The counterplan allows the development and testing of new tech that solves meltdowns.

Terry 16 [(Jeff Terry, Jeff Terry is a professor of physics at the Illinois Institute of Technology, where his main research focus is on energy systems) Use failing power plants to improve the safety and efficiency of clean energy, Bulletin of the Atomic Scientists March 31 2016] AT

Nuclear energy is currently the largest generator of low-carbon electricity in the United States. It could play an important role in mitigating climate change, but fears about safety impede its spread. These fears aren’t always grounded in reality. The US nuclear energy industry is overseen by two industry groups—the World Association of Nuclear Operators and the Institute of Nuclear Power Operators—and multiple government regulators dedicated to passing on lessons learned from nuclear accidents. It is one of the safest industries around in terms of occupational hazards. Severe accidents are rare, and nuclear professionals embrace a strong culture of safety. But is a culture of safety enough? And if it’s not, what can be done to improve? The answer may be found in some of the many US nuclear power plants in danger of closing their doors. The nuclear power industry could take a lesson from the history of car safety. The automobile industry saw a dramatic reduction in fatalities in recent years: From 1995 to 2009, the rate of fatalities per 100 million miles driven fell by 26 percent, with much of the decrease taking place from 2005 onward. What contributed to this large improvement in driver safety over such a short period? Certainly, there were big changes in cultural attitudes toward car safety. From 2006 to 2010, seat belt use by drivers increased from 81 to 85 percent. Calculations by the National Highway Traffic Safety Administration suggest a change of this magnitude would save around 800 to 900 lives per year. In fact, though, by 2010, fatalities were down by nearly 10,000 lives per year, as shown in Figure 1. So while the change in safety culture was significant, another factor must have also contributed to improved driver safety. During the 2000s, car manufacturers implemented many technical improvements to increase safety. These measures were aimed at both improving the odds of surviving a crash and avoiding accidents in the first place. Airbag technology and better passenger restraint systems are now the norm in automobiles. Advanced technology such as lane-change warnings and front collision avoidance systems were also deployed during this time. It took both improved safety culture and technological advances to significantly reduce car fatalities. There is a strong culture of safety in the nuclear power industry, but as the auto industry shows, you need technological improvement as well. Terry-auto-industry-graph.jpg That’s where those old power plants come in. It still remains difficult to implement new technology in the nuclear industry. One reason is that US nuclear plants are producing electricity at more than 90 percent of capacity. It is hard to justify experimenting with commercial reactors running so reliably. That makes it hard to test new technology, such as new fuels or claddings designed to improve safety on a commercial scale. A number of US commercial nuclear reactors are either likely to close or have already. The James M. FitzPatrick Nuclear Power Plant in New York is among those on the shutdown list. As it is a significant source of low-carbon electricity for the region, the state is trying to save it, in part by providing $100 million for fuel purchase. For the moment, though, that doesn’t seem to have reversed plant operator Entergy’s decision to close in less than a year. (Entergy has said it is closing for financial reasons, but some of us remain skeptical.) It may be, though, that struggling nuclear facilities offer a way to improve safety across the industry. The sector needs to be able to test new technology. In order to do that, the US Energy Department could take over soon-to-close reactors and run them as commercial-scale test facilities that also continue to produce clean electricity. One useful test, for example, would involve new claddings. Claddings are the materials around the radioactive fuel pellets that prevent the coolant from being contaminated. During the 2011 Fukushima nuclear power plant disaster, Zircaloy cladding reacted with steam at high temperature, which produced hydrogen that exploded. The industry would like to prevent this kind of thing from happening again. As a test, a plant operator could rotate fuels with new, non-hydrogen-producing claddings into different bundles in the reactor. By monitoring the process, researchers could see how the new claddings performed under normal operating conditions, and use the process to develop and test new sensors. In short, an Energy Department takeover of this kind would enable researchers to test new safety technologies on a commercial scale, while still allowing states to meet their clean energy goals. For the inconvenience of dealing with a test site, electricity for those living with 15 miles of the reactor could be provided for free or at reduced cost, as has been suggested in relation to a proposed public-private nuclear project in South Australia. This would be a novel use of a reactor that would otherwise just be closed and allowed to sit and decay for decades. Outgoing nuclear power plant operators would still be financially responsible for decommissioning, as laid out by US law, but they would benefit from the arrangement: While the Energy Department used the reactor as a testbed, the previous operator’s decommissioning fund would grow, so that by the time of final decommissioning, the original owner would have more funds and newer technology available for the task. In fact, the Energy Department could bring commercial-scale testing to other industries, too. Recent reports put California’s Ivanpah concentrated solar power plant in danger of closing. It would be a tremendous waste to allow the $2.2 billion dollar facility to close without giving researchers the ability to study what problems occurred. The ability to data mine Ivanpah’s weather and production information would be invaluable for improving future facilities. The site could also be used to test methods for preventing bird deaths and mitigating visual impact on pilots. Instead of wasting away in the desert, Ivanpah would be of valuable service to society. The Energy Department should not pass up the opportunity to take over closing facilities as commercial-scale testbeds to improve current energy technology. Having seen how new technology has improved safety in other industries, we need to make sure there is a method for testing new methods and materials in the energy sector as well. Resources like the FitzPatrick nuclear plant and the Ivanpah solar plant are too valuable to let fade away. It is in our best interest to allow researchers to collect data using these facilities. Subjecting that trove of information to new experimental techniques and computational data mining will allow scientists and engineers to make other facilities more efficient and safe. The Energy Department should take a lead role in keeping these no-longer-competitive commercial facilities alive. The data they provide can be used to improve our future.

## Increase Nuclear CP

### 1NC – Generic

#### Counter plan text: all relevant aff actors should expand their use of nuclear power

WNA 16 [World Nuclear Association, Association’s mission is to promote a wider understanding of nuclear energy among key international influencers by producing authoritative information, developing common industry positions, and contributing to the energy debate, “World Energy Needs and Nuclear Power,” June 2016, <http://www.world-nuclear.org/information-library/current-and-future-generation/world-energy-needs-and-nuclear-power.aspx>] JW

Nuclear Power for electricity in published scenarios Nuclear power generation is an established part of the world's electricity mix providing in 2012 some 11% of world electricity of 22,752 TWh (cf. coal 40.3%, oil 5%, natural gas 22.4%, hydro 16.5% and other 5%). It is especially suitable for large-scale, continuous electricity demand which requires reliability (i.e. base-load), and hence ideally matched to increasing urbanisation worldwide.OECD World Energy OutlookAnnual editions of the World Energy Outlook from the OECD International Energy Agency make clear the increasing importance of nuclear power in meeting energy needs while achieving security of supply and minimising carbon dioxide emissions. The 2006 edition of this report warned that if policies remained unchanged, world energy demand to 2030 is forecast to increase by 53% accompanied by supply crises, giving a "dirty, insecure and expensive" energy future which would be unsustainable. The report showed that nuclear power could make a major contribution to reducing dependence on imported gas and curbing CO2 emissions in a cost-effective way, since its uranium fuel is abundant. However governments needed to play a stronger role in facilitating private investment, especially in liberalized electricity markets where the trade-off between security and low price had been a disincentive to investment in new plant and grid infrastructure.The World Energy Outlook 2009 report said that investment of US$ 25.6 trillion\* would be required by 2030 under the reference scenario, and $10.5 trillion more under an alternative low-carbon energy scenario. Under this, nuclear capacity increases 378 GWe (86%) to 816 GWe rather than to 475 GWe in reference case, energy demand increases by 20% rather than 40% and CO2 emissions reduce to 26.4 Gt/yr from 28.8 Gt/yr in 2007.\* Of the $25.6 trillion amount, $13.7 trillion is for electricity: about half for generation and the rest for transmission and distribution.The World Energy Outlook 2010 report built on this and showed that removing fossil‐fuel consumption subsidies, which totaled $312 billion in 2009 (mostly in non-OECD countries), could make a big contribution to meeting energy security and environmental goals, including mitigating CO2 and other emissions. In the central New Policies scenario, based on recent policy advances, world primary energy demand increases by 36% between 2008 and 2035, or 1.2% per year average. This compares with 2% per year over the previous 27‐year period, but is higher than the low-carbon scenario. In this scenario, non-OECD countries account for 93% of the primary energy demand growth. The report notes that while China's energy use was half that of the USA in 2000, it overtook the USA in 2009.In the WEO 2010 New Policies scenario electricity demand was expected to grow at 2.2% pa to 2035, almost double the rate of primary energy, and with 80% of the growth being in non-OECD countries. Globally, gross capacity additions, to replace obsolete capacity and to meet demand growth, amount to around 5900 GWe to 2035 – 25% more than current installed capacity. Nuclear capacity increased by only 360 GWe, somewhat less than in the reduced carbon scenario. Support for renewable sources of electricity, estimated at $37 billion in 2009, is quadrupled. But per unit it drops from average 5.5 c/kWh to 2.3 cents, apart from costs of integrating them into the grid. CO2 emissions increase from 29 Gt/yr in 2008 to 34 Gt in 2020 and 35 Gt in 2035, all this being in non-OECD countries. In the low-carbon scenario they peak at 32 Gt about 2020 and drop to 22 Gt in 2035 with CO2 emission costs then being $90-120 per tonne (all in 2009 dollars). In the '450' low-carbon scenario to 2035, the additional spending on low‐carbon energy technologies (business investment and consumer spending) amounts to $18 trillion more than in the Current Policies Scenario, and around $13.5 trillion more than in the New Policies Scenario.

#### Nuclear produces more electricity by 2040

WNA 16 [World Nuclear Association, Association’s mission is to promote a wider understanding of nuclear energy among key international influencers by producing authoritative information, developing common industry positions, and contributing to the energy debate, “World Energy Needs and Nuclear Power,” June 2016, <http://www.world-nuclear.org/information-library/current-and-future-generation/world-energy-needs-and-nuclear-power.aspx>] JW

Nuclear power provides considerably more electricity by 2040 in all scenarios. From 2,478 TWh base in 2013, it increases to 4,606 TWh with New Policies, 3,974 under Current Policies, and 6,243 TWh in the 450 Scenario, then corresponding to 18% of supply. Under New Policies, 147 GWe is added by 2025, and another 218 GWe by 2040, both figures offset by retirements (62 & 86 GWe respectively). That scenario has much greater net addition for coal, gas, wind, solar and hydro, though it shows that the 2020 cost of electricity from non-hydro renewables is more than double that from nuclear, coal or hydro, though the difference diminishes by 2040.

### 1NC – US

#### Counterplan: Countries ought to substantially increase nuclear energy production using to encompass at least 50% of their energy production

**Becker et al 8**  Ulrich Becker (Professor Emeritus MIT Department of Physics), Bruno Coppi (Professor MIT Department of Physics), Eric Cosman(Professor Emeritus MIT Department of Physics), Peter Demos, Arthur Kerman (Professor Emeritus MIT Department of Physics), Richard Milner (Professor MIT Department of Physics) “A Perspective on the Future Energy Supply of the United States: The Urgent Need for Increased Nuclear Power” Vol. XXI No. 2 November / December 2008 http://web.mit.edu/fnl/volume/212/milner.html

The United States needs immediately to develop on a large scale an energy source which does not produce greenhouse gases, which is already known to be technologically feasible, and which is economical in view of projected costs of energy in the future. That energy source is nuclear fission. Nuclear fission power reactor technology was developed in the U.S. and has been utilized for electricity generation on a large scale across the globe for half a century. For example, France produces about 70% of its electricity using nuclear power. In the U.S. about 20% of the electricity used is produced using nuclear power. However, there are states where it is significantly larger, e.g., in Illinois about 50% of electricity is generated by nuclear power. The U.S. should establish the goal to produce half of its electricity by means of nuclear power as soon as feasible. This will have the effect of reducing greenhouse gas emissions, avoiding the risk of an “energy gap” in supply, and providing valuable time for new energy technologies to be developed. This goal would fast track and increase the projected levels of nuclear power over the scenarios considered in several energy studies, including the 2003 MIT study, The Future of Nuclear Power. A Change in U.S. Government Policy and Leadership is Needed The expansion of nuclear power in the U.S. requires a major change in U.S. government policy and a change in the U.S. public’s perceptions. In the past 30 years there has been criticism of nuclear fission power that has raised the American public’s concern; however, this criticism must be viewed today in the context of national energy needs and the positive experience that has been gained from the use of nuclear power. The criticism has related primarily to nuclear reactor safety, storage and environmental risks of nuclear waste, proliferation of nuclear materials that could be used in weapons, and the cost of nuclear power relative to coal, natural gas, and oil. In each of these cases, the problems are either solvable, have been exaggerated in view of decades-long experience, are insignificant compared to a national economic crisis or international hostilities caused by a gap in U.S. energy supply, or are insignificant compared to the dangers of greenhouse gas emissions. The safety record for reactors has been excellent, and safety can be further assured by improved reactor design. There are many decades of experience of safe handling, storage, and monitoring of radioactive materials worldwide. In addition, there are now several possible strategies that would actually use the existing waste to produce energy, thereby increasing the long-term availability of nuclear energy. The U.S. must be an example for major greenhouse gas-emitting countries possessing nuclear technology, e.g., China, India, and Russia, in committing to a considerable reduction in global emissions. The cost of nuclear power becomes less important as foreign fuel prices spiral upward, and if the carbon tax factor is included, nuclear power becomes very economically important. Further, the cost of nuclear power would be irrelevant if our economy were to collapse from a cutoff of oil supply, or worse, if we had to go to war to secure our energy supply. A Call for Action Today the advancement of nuclear power in the U.S. is crippled by governmental policy, regulation, and misconceptions. In the long term, it is reasonable to expect that the energy needs of the U.S. will be met from a number of different sources, only one of which will be nuclear fission. However, to ensure the energy security of the Nation in the medium term and to allow time for the development of new energy technologies which can drastically reduce greenhouse gas emissions, the U.S. needs to initiate immediately a program to implement nuclear fission reactors on a large scale. As with the construction of the national highway system, the space program, the Manhattan Project, and the subsequent support of science, especially nuclear science, in the U.S. beginning in the late 1940s, such an ambitious goal can be realized only if it is established as a high national priority, particularly taking into account the fact that dealing with the energy problem is considerably more complex and difficult than any of the aforementioned projects. An urgent call to action is needed by the leadership of this nation. This call to action by our leaders would resonate strongly with the citizens of the United States, especially with the recent 1price of oil at record levels. Successful realization will require streamlining of the permitting process to contain costs. It will require substantial resources from the federal government to implement the most technically advanced reactor designs, and will require the full participation by the best and brightest in private industry, government laboratories, and academic institutions across the nation. A substantial investment to support a new generation of nuclear scientists and engineers must be made to make this realization possible.

### A2 Renewables

#### Renewables aren’t good now and need time. NP in the short run is much better

**Gross 16** Daniel Gross Executive Editor at strategy+business Harvard University A.M. “Why Renewable Power Can Still Be Wasteful” The Slate JULY 29 2016 12:38 PM

And yet, given the way the U.S. has gone about adding renewables to the grid, there actually is a fair amount of inefficiency and wasted energy. On any given day, a certain amount of wind and solar power is curtailed, as the term of art goes. Wind turbines, for example, get turned off even though the blades are still turning; the production of solar plants sometimes gets dialed down. In early July in California, for about an hour one afternoon, some 292 megawatts of solar capacity was curtailed—enough to power thousands of homes. Why do we have curtailment? Blame the herky-jerky way we roll out new technologies and build infrastructure in this country. Inefficiencies in new economic infrastructure aren’t exactly new. Because the state doesn’t centrally plan and roll out new technologies in a completely rational fashion—matching demand, distribution, and supply—wrinkles and bubbles develop. Incentives may be available for one component of the technology but not for others. And so overinvestment in one stage of the process coincides with underinvestment in another stage. Which is why we have bubbles. The earliest telegraph lines from Boston to New York City stopped at the Hudson River—and messages had to be carried across the Hudson on a boat. In the 1990s, information would travel at rapid speeds across the country on fast cables but slow down in the last mile. (I wrote a book about this in 2007.) The same has happened with wind and solar. There are significant government incentives to build wind and solar farms in the plains and deserts, where land is cheap and resources are plentiful. The U.S. renewable industries have figured out how to build and finance wind and solar farms at scale. But the transmission and the distribution systems, which don’t benefit from the same incentives, haven’t kept up. Transporting electricity involves stringing high-voltage lines across hundreds of miles of open space, across property owned by thousands of owners and multiple state lines. You can put up a giant solar farm or a wind farm in a matter of months. But as the travails of transmission-builder Clean Line Energy show, building the lines that will carry electrons from the places where they are created to the places they can be used can take decades. The design of the grid also works against efficiency. Texas maintains an electricity grid that is not connected to its neighboring states. And so when the huge wind farms built in the state generate power at times when demand is low, strange things can happen—like negative prices for their energy output. And even states in which grids are interconnected, there’s often a mismatch between demand and the amount of power generated during periods of peak usage in the late afternoon, leading to price spikes. And, of course, the very nature of renewables also works against efficiency. Plants powered by coal and natural gas can guarantee steady production over the course of the day, and dial output up and down with great precision as demand changes. But wind and solar are famously intermittent sources, so the task is harder. With solar, clouds and weather patterns can affect the intensity of solar radiation. The ability of solar panels to produce electricity varies dramatically over the course of the day. Winds can gust and die down in ways that defy easy prediction. So in the middle of the day, when solar panels are producing the maximum output and demand tends to be low, there may not be users for all the electricity being produced. And at night, when the wind blows powerfully and the world is asleep, there may not be takers for the power at any price. That’s when you get curtailment, or energy waste. Curtailment is most pronounced and frequent in energy islands: geographical islands like Hawaii and electricity islands like Texas. Generally speaking, wind power is the most likely to be curtailed. In 2009, some 17 percent of the wind generation in Texas was curtailed. But as the state built new transmission lines to connect the wind farms to population centers, the rate has declined. As this exhaustive report from the Energy Department notes: Only 0.5 percent of all wind generation within the coverage area of the Electric Reliability Council of Texas was curtailed in 2014, down from the peak of 17 percent in 2009. (Here’s a chart of curtailments in Texas between 2011 and 2014.)

### Energy Dependence Net Benefit

#### U.S. highly dependent on oil and new technologies unlikely to be realized

Becker et al 08 [Ulrich Becker, Professor emeritus of physics at Massachusetts Institute of Technology, “A Perspective on the Future Energy Supply of the United States: The Urgent Need for Increased Nuclear Power,” MIT Faculty Newsletter Vol. XXI No. 2, November/December 2008] JW

The reliable and affordable availability of energy is the lifeblood of human civilization in the twenty-first century. It is essential to the quality and security of everyday life of the citizens in the United States. For example, the sudden loss of electrical power invariably reduces living conditions of the most technologically advanced society to a primitive state. The protracted loss of electric power would lead to chaos in the United States, with resultant instability worldwide. Recently, it has become clear that the future energy security of the United States is at serious risk from two different sources. Most of the energy used in buildings, industry, and transportation arises from the chemical burning of fossil fuels. The waste produced in the burning process includes greenhouse gases (e.g., carbon dioxide, methane) which for the last 200 years have accumulated in the Earth’s atmosphere. The present concentration of carbon dioxide in the Earth’s atmosphere is estimated as 385 ppm, which substantially exceeds the estimated values over the last 500,000 years. Basic scientific arguments tell us that the increased carbon dioxide levels should result in heating of the Earth’s surface. Measurements indicate that the average temperature at the Earth’s surface has significantly risen over the last 100 years. If humanity wishes to preserve the planet on which human civilization developed, significant changes in the way we produce energy are urgently required. This is a global security challenge where the U.S. must play a leadership role. Secondly, the energy supply of the United States relies to a great degree on the reliable and affordable availability of oil. For example, transportation (road, rail, sea, air) depends almost completely on oil. The world’s supply of oil is limited and it is located in many regions of the world which are politically unstable and unfriendly to the United States. In addition to this, it is possible that the total world oil supply may have already peaked. In the last two decades, the U.S. has been involved in two wars in the Middle East where the world’s major source of oil is located. Until the U.S. dependence on foreign oil is significantly reduced, there is every expectation that increasing amounts of precious U.S. blood and treasure will have to be expended in widening conflicts in the cause of energy security. It is widely accepted that the U.S. must find a way to wean itself from its addiction to oil. In ground transportation, which is a major oil consumer, significant progress is being made with batteries and fuel cells to replace gasoline with electricity, which can be generated in alternative ways. Strongly motivated by these two considerations, the development of new technologies to increase energy efficiency and to produce reliable and affordable energy with minimal greenhouse gas emission to the Earth’s atmosphere is a high priority in the U.S. and in many other countries. It is essential that these efforts be encouraged and enhanced. However, the probability of success and the timescale for realization of these technologies is highly uncertain. The economic stability and national security of the United States over the coming decades cannot be secured by assuming optimistically that these new technologies will succeed in time to avoid a major discontinuity in the supply of oil and gas from foreign and potentially hostile sources. Further, it is not acceptable, nor is it possible, that the U.S. continues to burn fossil fuels indefinitely at present levels, thereby putting in clear jeopardy the planet on which we have evolved.

#### Increasing nuclear power is key to buying time for development of new tech

Becker et al 08 [Ulrich Becker, Professor emeritus of physics at Massachusetts Institute of Technology, “A Perspective on the Future Energy Supply of the United States: The Urgent Need for Increased Nuclear Power,” MIT Faculty Newsletter Vol. XXI No. 2, November/December 2008] JW

Today the advancement of nuclear power in the U.S. is crippled by governmental policy, regulation, and misconceptions. In the long term, it is reasonable to expect that the energy needs of the U.S. will be met from a number of different sources, only one of which will be nuclear fission. However, to ensure the energy security of the Nation in the medium term and to allow time for the development of new energy technologies which can drastically reduce greenhouse gas emissions, the U.S. needs to initiate immediately a program to implement nuclear fission reactors on a large scale. As with the construction of the national highway system, the space program, the Manhattan Project, and the subsequent support of science, especially nuclear science, in the U.S. beginning in the late 1940s, such an ambitious goal can be realized only if it is established as a high national priority, particularly taking into account the fact that dealing with the energy problem is considerably more complex and difficult than any of the aforementioned projects. An urgent call to action is needed by the leadership of this nation. This call to action by our leaders would resonate strongly with the citizens of the United States, especially with the recent 1price of oil at record levels. Successful realization will require streamlining of the permitting process to contain costs. It will require substantial resources from the federal government to implement the most technically advanced reactor designs, and will require the full participation by the best and brightest in private industry, government laboratories, and academic institutions across the nation. A substantial investment to support a new generation of nuclear scientists and engineers must be made to make this realization possible.

### SMRs Net Benefit

#### Nuclear power would turn to SMR’s which is cheaper

Iyer et al 14 - Gokul Iyer, Nathan Hultman, and Steve Fetter of the School of Public Policy, University of Maryland, Son H. Kim of the Joint Global Change Research Institute, Pacific Northwest National Laboratory and University of Maryland: 6 July 2014 (“Implications of small modular reactors for climate change mitigation” Elseiver Ltd. Journal of Energy Economics, p. 1, Available Online at http://www.karnteknik.se/upload/aktiviteter/medlemsaktiviteter/20151009\_Staffan%20Qvists%20Energy%20Policy.pdf, Accessed 8/8/16)IG

Achieving climate policy targets will require large-scale deployment of low-carbon energy technologies, includ- ing nuclear power. The small modular reactor (SMR) is viewed as a possible solution to the problems of energy security as well as climate change. In this paper, we use an integrated assessment model (IAM) to investigate the evolution of a global energy portfolio with SMRs under a stringent climate policy. Technology selection in the model is based on costs; we use results from previous expert elicitation studies of SMR costs. We find that the costs of achieving a 2 °C target are lower with SMRs than without. The costs are higher when large reactors do not compete for market share compared to a world in which they can compete freely. When both SMRs and large reactors compete for market share, reduction in mitigation cost is achieved only under advanced assump- tions about SMR technology costs and future cost improvements. While the availability of SMRs could lower mit- igation costs by a moderate amount, actual realization of these benefits would depend on the rapid up-scaling of SMRs in the near term. Such rapid deployment could be limited by several social, institutional and behavioral obstacles. 1. Introduction The international community has established a target of keeping global mean temperature rise below 2 °C in order to prevent dan- gerous anthropogenic interference with the climate system (UNFCCC, 2010). Achieving such stringent climate goals will require substantial reductions—in the order of 50% below current levels— in the emissions of greenhouse gases(GHG) by 2050 and deeper cuts beyond (IPCC, 2007). Nuclear energy, along with other low-carbon technologies, is expected to play a significant role in contributing to the growing demand for energy without emitting CO2 (IAEA, 2013; Kim and Edmonds, 2007). However, perspectives vary widely on the potential for substantial increases in the deployment of nuclear power— a divergence that hinges on expectations of future cost reductions, risk of accident, proliferation dangers, waste dis- posal solutions and public acceptance of conventional nuclear power (see for example, Dittmar, 2012; Joskow and Parsons, 2012). In this context, there has been considerable interest in small modular reactors (SMRs) which are defined by the Internation- al Atomic Energy Agency (IAEA) as reactors whose sizes are smaller than 300 MWe (IAEA, 2012). Proponents view these reactors as more likely to overcome many of the problems faced by the nuclear industry today, with improved economics, proliferation resistance, and easier integra- tion into energy systems. They promise to provide an improved ap- proach to the dual problems of energy security and climate change, especially in the developing world. However, like any new technology, SMRs face a number of challenges for successful commercial de- ployment. Current cost estimates are highly uncertain because of the early stage of development, and the evolution of SMRs in the overall portfolio—competing with not only conventional nuclear but also all other energy sources—is therefore hard to estimate without a systematic method. In this paper, we investigate the implications of the availability of SMRs as a technology alternative for climate change mitigation. To do so, we add a new technology category of SMRs to an integrated assess- ment model (described in Section 3.1), and use cost estimates from the recent expert elicitation published by Abdulla et al. (2013). Then, we seek to answer the following questions: How much would the availabil- ity of SMRs impact the costs of achieving a stringent climate policy tar- get? How would these impacts change if there is no new investment in large reactors? 2. Background 2.1. Technical and economic advantages of the SMR option Three major types of SMR designs are being developed (see Vujić et al., 2012; Kessides and Kuznetsov, 2012; WNA, 2013a for comprehen- sive reviews of SMR designs). The first type is based on the pressurized water reactor (PWR) technology, which is in widespread use today in large reactors. Examples include the International Reactor Innovative and Secure (IRIS), which involves an international team coordinated by Westinghouse; the Russian KLT-40 and VBER-300; the NuScale 45 MWe; the Babcock and Wilcox 180 MWe mPower and the Westing- house 225 MWe (Carelli et al., 2004; IAEA, 2012; NuScale, 2013; Vujić et al., 2012; Westinghouse, 2013). In addition to the PWR concept, some SMR designs are also based on the boiling water reactor and heavy water reactor concepts (IAEA, 2012). The second type consists of high temperature gas-cooled reactors (HTGRs) that use helium gas as the coolant and graphite as moderator. The outlet temperature of the secondary fluid in these reactors is typically very high, which makes these reactors useful for cogeneration applications. Examples in- clude the ANTARES developed by AREVA, the Chinese Shidaowan pro- ject and the Gas Turbine Modular Helium Reactor (GT-MHR) by General Atomics (WNA, 2013a, 2013b). The third group includes SMRs that are cooled by liquid metal or molten salt. An example is the Toshiba 50 MWe S4 sodium-cooled fast reactor. The latter design con- cepts are expected to be the most difficult to license, since there is not much experience in operating such reactors or available test facilities for verifying new designs (Vujić et al., 2012). From an economic standpoint, the smaller size of the SMR means a potential loss of economies of scale in generation associated with large re- actors, but promises future economies of scale in manufacture and de- ployment. Recent expert elicitations have reported higher overnight (capital) costs for SMRs compared to GW-scale Gen II and Gen III systems (Abdulla et al., 2013; Anadon et al., 2012; Anadón et al., 2013).

Neverthe- less, SMRs have a number of technical and economic advantages com- pared to large reactors (Carelli et al., 2010; Ingersoll, 2009; Kessides and Kuznetsov, 2012; Kuznetsov, 2008; Rosner and Goldberg, 2011). First, un- like large reactors, SMR designs are compact because a number of compo- nents such as steam generators, pressurizer and reactor coolant pumps are integrated within the reactor vessel itself rather than outside of the re- actor. Most SMR designs incorporate passive safety features1 that reduce or eliminate the risk of fuel damage and radiation releases related to loss of coolant or loss of coolant flow. In addition, other features of the SMR such as a larger surface-to-volume ratio and reduced core power density facilitate easier removal of heat and the use of advanced passive features (Bae et al., 2001; Carelli et al., 2004; IAEA, 2009). SMRs also have a smaller fuel inventory which reduces the maximum possible release during an adverse event (Kessides, 2012). Second, because of their smaller sizes, SMRs would require reduced construction times and therefore smaller interest payments during con- struction (Abdulla et al., 2013). In other words, SMRs are likely to be fi- nancially less risky compared to large reactors. Third, the modularity of SMRs permits scaling the power plant to larger sizes based on incre- mental needs for energy and compatibility with the electrical grid infra- structure. Modularity offers other benefits not only by reducing the front-end investment and facilitating initial deployment but also en- hancing temporal and spatial flexibility in investment. The latter feature is an important distinction from large reactors because it creates an op- tion value: under uncertainty in future electricity prices, investment in large reactors is very risky as a large portion of the investment is sunk and irreversible. On the other hand, in spite of higher overnight costs, the modularity feature of SMRs offers a better control over market risk to investors (as investment can be split more easily to match market de- mand) and so the risk premium is lower (Gollier et al., 2005). Finally, SMRs can be mass produced in a factory and shipped to the site. Mass production could facilitate and accelerate cost reductions due to learning. Empirical evidence on cost reductions due to increasing capacity in the nuclear industry is mixed. In the past, several scholars found evidence of learning and experience spillovers leading to a lower- ing of costs in the nuclear industry (Lester and McCabe, 1993; Zimmerman, 1982). On the other hand, other scholars argued that in- creased construction times due to increased size and complexity of re- actors coupled with new environmental, health and safety regulations led to escalating capital as well as operating and maintenance costs (Cantor and Hewlett, 1988; Hewlett, 1996; Joskow and Rose, 1985). Similar findings have been reported by more recent studies that empha- size that the site-specific nature of deployment makes standardization difficult, so cost reductions have not been achieved and are not likely in the future (Cooper, 2010; Grübler, 2010; Hultman and Koomey, 2007; Hultman et al., 2007). However, in the case of SMRs, several scholars argue that cost savings can be achieved through off-site fabrica- tion of modules (which facilitates standardization), as well as learning- by-doing through the production of multiple, simple modules with shorter construction times (Abdulla et al., 2013; Kessides, 2012; Rosner and Goldberg, 2011). In addition, Rangel and Lévêque (2012) used detailed data for French reactors and argued that while overall ex- perience did not translate into lower costs, some gains were achieved due to the construction of standard reactor types. This finding is rele- vant to SMRs, which are likely to be co-sited and the same type of reac- tors are likely to be produced in larger numbers (Abdulla et al., 2013; Carelli et al., 2010). In the subsequent section, we discuss some of the policy rationales put forth by SMR proponents for promoting the de- ployment of SMRs. 2.2. Policy rationales for promoting SMRs Scholars have put forth a number of rationales for promoting SMRs. One important rationale for promoting nuclear energy in general and SMRs in particular is improving energy security. Access to energy sources depends on a complex system of global markets, vast cross-border infra- structure networks, a small group of primary energy suppliers, and inter- dependencies with financial markets and technology. Industrialized as well as developing nations have shown renewed focus on energy security because of the exceedingly tight oil market, high oil prices, instability in some exporting nations and geopolitical rivalries (Chester, 2010; Yergin, 2006). Nuclear power has been relatively unaffected by disruption in commodity markets. Natural uranium represents a very small fraction of the price of nuclear electricity, and uranium resources are spread throughout politically stable regions; the largest producers and exporters are Canada and Australia (IAEA, 2013). SMR proponents argue that be- cause of their small size and inherent safety features, SMRs could be sited in areas with small electric grids or in remote locations with little or no grid access, thereby accessing a wider range of markets than is pos- sible with traditional reactor technology (Kessides and Kuznetsov, 2012; Kuznetsov, 2008). Another rationale cited for encouraging the deployment of SMRs is to make use of the “early mover advantage” (Kim and Chang, 2012; SEAB, 2012). SMRs are relatively new entrants in the energy markets and promoting SMRs could improve the positioning and competitive- ness of domestic industries in the global value chain and also create em- ployment opportunities. For example, Denmark became a world leader in wind energy by mastering the commercialization process (Lund, 2009). This not only improved the international competitiveness of the industry but also compensated for the welfare loss in the infant pe- riod (Hansen et al., 2003).

#### Solves the whole case:

#### SMR’s are substantially smaller, they’re also underground which checks your surface waste arguments.

#### Competition checks your safety objections- SMR’s are the newest competition to big plants which encourages both to get better under capitalism- that competition didn’t *exist before these recent developmenets especially since your evidence assumes SMR’s don’t exist.*

### Short CP Text

#### CP Text: The United States should increase nuclear power

Becker et al 08 [Ulrich Becker, Professor emeritus of physics at Massachusetts Institute of Technology, “A Perspective on the Future Energy Supply of the United States: The Urgent Need for Increased Nuclear Power,” MIT Faculty Newsletter Vol. XXI No. 2, November/December 2008] JW

The United States needs immediately to develop on a large scale an energy source which does not produce greenhouse gases, which is already known to be technologically feasible, and which is economical in view of projected costs of energy in the future. That energy source is nuclear fission. Nuclear fission power reactor technology was developed in the U.S. and has been utilized for electricity generation on a large scale across the globe for half a century. For example, France produces about 70% of its electricity using nuclear power. In the U.S. about 20% of the electricity used is produced using nuclear power. However, there are states where it is significantly larger, e.g., in Illinois about 50% of electricity is generated by nuclear power. The U.S. should establish the goal to produce half of its electricity by means of nuclear power as soon as feasible. This will have the effect of reducing greenhouse gas emissions, avoiding the risk of an “energy gap” in supply, and providing valuable time for new energy technologies to be developed. This goal would fast track and increase the projected levels of nuclear power over the scenarios considered in several energy studies, including the 2003 MIT study, The Future of Nuclear Power.

#### Mutually exclusive with the aff: aff prohibits nuclear power while the CP continues and increases it

### A2 Nuclear Power Dangerous

#### Concerns about nuclear power are overblown and the U.S. needs to set an example for other countries

Becker et al 08 [Ulrich Becker, Professor emeritus of physics at Massachusetts Institute of Technology, “A Perspective on the Future Energy Supply of the United States: The Urgent Need for Increased Nuclear Power,” MIT Faculty Newsletter Vol. XXI No. 2, November/December 2008] JW

The expansion of nuclear power in the U.S. requires a major change in U.S. government policy and a change in the U.S. public’s perceptions. In the past 30 years there has been criticism of nuclear fission power that has raised the American public’s concern; however, this criticism must be viewed today in the context of national energy needs and the positive experience that has been gained from the use of nuclear power. The criticism has related primarily to nuclear reactor safety, storage and environmental risks of nuclear waste, proliferation of nuclear materials that could be used in weapons, and the cost of nuclear power relative to coal, natural gas, and oil. In each of these cases, the problems are either solvable, have been exaggerated in view of decades-long experience, are insignificant compared to a national economic crisis or international hostilities caused by a gap in U.S. energy supply, or are insignificant compared to the dangers of greenhouse gas emissions. The safety record for reactors has been excellent, and safety can be further assured by improved reactor design. There are many decades of experience of safe handling, storage, and monitoring of radioactive materials worldwide. In addition, there are now several possible strategies that would actually use the existing waste to produce energy, thereby increasing the long-term availability of nuclear energy. The U.S. must be an example for major greenhouse gas-emitting countries possessing nuclear technology, e.g., China, India, and Russia, in committing to a considerable reduction in global emissions. The cost of nuclear power becomes less important as foreign fuel prices spiral upward, and if the carbon tax factor is included, nuclear power becomes very economically important. Further, the cost of nuclear power would be irrelevant if our economy were to collapse from a cutoff of oil supply, or worse, if we had to go to war to secure our energy supply.

## Repository CP

### 1NC

#### CP Text: Countries ought to store nuclear waste in stable geological formations.

#### Solvency Advocate

Picot et al 01: **[**Picot, Cynthia. Riotte, Hans. Leon Jorge Lang-Leton. Jorge Lang-Leton Leon is Director of Communication ENRESA (Spain), Cynthia Picot and Hans Riotte are in the Nuclear Energy Agency (NEA). (2001). Sustainable solutions for radioactive waste. *The Observer.* http://www.oecdobserver.org/news/fullstory.php/aid/531/Sustainable\_solutions\_for\_radioactive\_waste.html#sthash.Y4rlNKGP.dpuf]

**The long-term solution** currently **preferred by specialists** consists of **plac[es]**ing the **waste in a deep** (500 metres below the surface) and **stable geological** setting**, such as granite,** clay, tuff **and salt formations** **that have remained** virtually **unchanged for millions of years**. The aim is to ensure that such **wastes will remain undisturbed for the few thousand years needed for their levels of radioactivity to decline** to the point where they no longer represent a danger to present or future generations. The concept of deep geological disposal is more than 40 years old, and **the technology for building and operating such repositories is now mature enough for deployment**. As a general rule, the **natural security afforded** **by** **the** chosen **geological formation is enhanced by additional precautionary measures**. The **wastes are immobilised** in an insoluble form, in blocks of glass for example, and then placed **inside corrosion-resistant containers;** spaces between waste packages are filled with highly pure, impermeable clay; and the repository may be strengthened by means of concrete structures. **Th[is]**ese successive barriers are mutually reinforcing and together **ensure[s] that wastes can be contained** over the very **long term**. The waste can be recovered during the initial phase of the repository, and also during subsequent phases, albeit at increased cost. This provides freedom of choice to future generations to change waste management strategies if they wish. - See more at:

### Solves Natives

#### Current Nuclear waste disposal causes extensive harms.

Kurkreja 16

(Kukreja, Rinkesh. “Nuclear Waste Disposal.” Conserve Energy Future. 2016 <http://www.conserve-energy-future.com/dangers-and-effects-of-nuclear-waste-disposal.php> )

1. Long Half Life: The products of nuclear fission have long half lives, which means that they will continue to be radioactive – and therefore hazardous- for many thousands of years. This means that, if anything were to happen to the waste cylinders in which nuclear waste is stored, this material can be extremely volatile and dangerous for many years to come. Since hazardous nuclear waste is often not sent off to special locations to be stored, this means that it is relatively easy to find, and if anyone with ill intent were to look for nuclear waste to serve unpleasant purposes, they may well be able to find some and use it. 2. Storage: Another problem with nuclear waste disposal that is still being discussed today is the issue of storage. Many different storage methods have been discussed throughout history, with very few being implemented because of the problematic nature of storing such hazardous material that will remain radioactive for thousands of years. Amongst the suggestions that were considered as above ground storage, ejection into space, ocean disposal and disposal into ice sheets. Of these, only one was implemented – ocean disposal was actually used by thirteen different countries and was the method of dumping radioactive waste into the oceans in order to get rid of it. Understandably, this practice is no longer implemented. 3. Affects on Nature: One of the biggest concerns that the world has with the disposal of nuclear waste is the affect the hazardous materials could have on animals and plant life. Although most of the time the waste is well sealed inside huge drums of steel and concrete, sometimes accidents can happen and leaks can occur. Nuclear waste can have drastically bad effects on life, causing cancerous growths, for instance, or causing genetic problems for many generations of animal and plants. Not disposing of nuclear waste properly can therefore have huge environmental impacts that can harm many millions of animals and hundreds of animal species.

#### Thus, geological repositories avoid dumping – solves case

### Safety

#### CP solves - lack of storage options for nuclear storage create security risks.

McCombie et al. 1 [https://www.sea-us.org.au/wastedump/McCombie.pdf]

Security is the term used when discussing a different type of hazard potentially arising from nuclear materials.Highly enriched **uranium and plutonium are fissile materials, which can be used to make nuclear explosives. It is imperative to ensure that such materials do not get** illegally diverted and **misused**. Global civil stocks of separated plutonium from reprocessing of spent fuel may exceed 250 tonnes by the year 2010 – and less than 10 kg will suffice for a crude nuclear bomb. **Moreover, the** **welcome move towards disarmament** by the major weapons states **is**, in the short term, **increasing the hazard potential**. Some 200 tonnes of plutonium and 2000 tonnes of highly enriched uranium will become available for other purposes as surplus weapons are dismantled. Given the drastic economic conditions in Russia, for example, the temptations of individuals to divert valuable nuclear materials are large. **Society must** face the challenge of **ensur[e]**ing **that** the weapons grade **materials are** converted into forms unsuited for use in bombs and are **safeguarded** permanently from misuse.

#### Solves safety issues – repositories are solid

McCombie et al. 1 [https://www.sea-us.org.au/wastedump/McCombie.pdf]

**A geologic repository provides ultimate protection** by ensuring that radioactive materials emplaced within the facility can never return to the environment in concentrations, which could be harmful. **This is achieved by several safety barriers**, which function both in series and parallel. The barriers are usually described as: Waste form – the **radionuclides are immobilized in a highly insoluble**, corrosion resistant **form** such as glass or synthetic minerals; the leaching of radionuclides from the waste in a deep geologic environment will require tens or hundreds of thousands of years. Containers – a durable container around the immobilized waste material can provide substantially complete containment for thousands of years. **Backfill[s]** – the gaps between the waste containers and the walls of the boreholes or tunnels into which they are placed is filled with a material, which **provide**s mechanical **support and can also retard** movement ofgroundwater and the **migration of radionuclides**. The geological medium – this can provide a suitable mechanical and chemical environment for the waste for extremely long times, up to a million years or more; it also prevents any rapid movement of groundwater through the repository and will retard geochemically any radionuclides which could be leached from the waste. The net effect of **this multibarrier system** is to **ensure[s]** that, for correctly sited, designed and constructed repositories, **no releases of radionuclides from the repository** can occur for very long times and no significant concentrations of radionuclides will ever reach the biosphere.

## Reprocessing CP

### 1NC CP

#### CP: All countries with nuclear production capabilities will transition from a system of direct disposal of nuclear waste to reprocessing.

#### Mutually exclusive: Recycling of nuclear waste necessitates use of nuclear power production.

#### Solves disposal problems and energy dependency

Upton 13

(Upton, John. John Upton is a freelance journalist based in New Delhi, India. His work has appeared in The New York Times and Grist. “Our Nuclear Waste is a Goldmine”. Nautilus. 2013.<http://nautil.us/issue/7/waste/our-nuclear-waste-is-a-goldmine> )

**If America’s nuclear waste could be turned into electricity, it could power the country for the next century**. More than **77,000 tons of** plutonium, americium, and other **radioactive** **leftovers** of uranium fission **have piled up** at America’s atomic power plants, turning them into radioactive waste warehouses. **Known as transuranics, these materials remain radioactive for thousands of years**, and are stored in above-ground, concrete-encased water pools and steel casks, **fueling endless political battles about where they should be buried**. In August 2013, the United States Court of Appeals for the District of Columbia Circuit ordered the government to resume planning for the Yucca Mountain dump site, but the Nuclear Regulatory Commission says it lacks the money. But **there is a better solution: Nuclear waste can be turned into electricity. A new generation of nuclear reactors**, dubbed Gen-IV reactors, **could do it with great efficiency**. In the process, **transuranics would be broken into elements that remain radioactive for a** much **shorter period of time**, thus **alleviating** both our energy and **our waste issues**. As a country, **we are sitting on a radioactive gold mine**. But the economics of mining that gold are complicated. To make the new reactors work, new economic policies have to work first. The existing U.S. nuclear reactors (and most other reactors in the world) use light-water technology in which uranium rods are dunked in water, which serves as a coolant. Uranium atoms release energy when they undergo fission: After capturing a moving neutron, they split into two new elements, releasing two or three neutrons as well as heat, which boils water into steam that spins a turbine to generate electricity.1 A series of subsequent atomic reactions creates plutonium and other elements. For the fission reaction to continue, the released neutrons need to collide with uranium atoms. But the neutrons move too quickly to be captured. They need to be slowed down, which is done by using water that surrounds the rods. The water molecules slow down the neutrons to the speed needed for a sustained fission reaction. **Only 5 percent of uranium atoms are used up by the time the rod** becomes filled with fission products and **is taken out of the reactor to be added to our stockpile of nuclear waste**. The rod’s plutonium atoms, and its remaining uranium atoms, can undergo further fission in light-water reactors, but at low efficiency. Plutonium needs fast-moving neutrons to split its atoms. Reactors with fast neutrons are called fast reactors, and Gen-IV reactors are one example. Running spent uranium rods through **Gen-IV reactors would allow the energy** in those rods **to be extracted** almost **completely. “Instead of extracting 5** or 6 **percent of the energy** out of the fuel, **you could get** much closer to **95 percent** or so,” says Paul Genoa, senior director of policy development at the Nuclear Energy Institute, a trade association for the nuclear energy industry. Furthermore, **a Gen-IV reactor would produce elements that decay** much quicker than the transuranics. “The transuranics have half-lives **in** the order of hundreds of thousands of years,” says GE Hitachi Nuclear Energy’s technology chief Eric Loewen. “But after we’ve broken them down into iodine and other elements they have half-lives in the order of **10 to 30 years.”** GE Hitachi has completed design work on a Gen-IV fast reactor called PRISM (Power Reactor Innovative Small Module), and is ready to offer it to power companies. In a PRISM reactor, plutonium fuel rods would be suspended in a mass of liquid sodium. The heat from nuclear reactions would boil the water on the outside of the reactor core’s casing; the steam would rise and spin turbines to produce electricity. The fast reactor idea isn’t new. But not a single fast reactor has been built in six decades. The first reactor built in the U.S., which began operating in 1951, was a fast reactor. It was capable of using both uranium and the plutonium produced by uranium fission reactions. Back then uranium was thought to be a rare commodity, so it was important for reactors to extract the maximum out of the fuel. When geologists discovered that Earth had plenty of uranium, it became cheap and widely used, eliminating the need for more efficient reactors. Fast reactors that used sodium also raised safety concerns. Sodium is highly combustible and reacts violently with water. Fast reactors in Russia and India had fires because of sodium leaks. But GE Hitachi says it designed PRISM to be leak-proof because the reactor would be contained inside a stainless steel case, which wouldn’t corrode. There is also a leak-detecting system. And, Loewen says that compared to light-water reactors, PRISM has safety advantages too, because the fuel, coolant, and cladding are all made of metal, which has a lower thermal resistance than water. In case of overheating it’s easier for heat to escape from the reactor vessel into the air without blowing up pumps and valves. (Lead or molten salt can also serve as coolant in fast reactors, but sodium has an important advantage—it doesn’t corrode stainless steel.)  The technical problems around fast reactors, then, have been significantly reduced. Now the main obstacle seems to lie in economics. Fast reactor technology is expensive and currently is “not economical,” says Per Peterson, a professor at the University of California at Berkeley’s Department of Nuclear Engineering. GE Hitachi’s typical water-based reactor produces 1,600 megawatts of electricity, while a PRISM unit would produce approximately 600.  It’s cheaper for the nuclear industry to build light-water reactors that produce waste than to invest in fast reactors that eat it up. Raising the wholesale price of nuclear energy is not viable when fracked natural gas keeps electricity costs low. In fact, low electricity prices have contributed to the closures or pending closures of nuclear power plants in California, Wisconsin, Vermont, Florida, and New Jersey. “The industry is in a fragile situation right now,” says Genoa of the Nuclear Energy Institute. “What we don’t want do to is be forced to bear the burden of developing this recycling technology before it’s economically feasible.” Peterson thinks the technology will naturally find its path to market. “If **fuel is easy to fabricate from recycled materials, then that will be the least expensive source,”** he says.

#### Reprocessing waste significantly reduces levels of nuclear waste.

Maehlum 13

(Maehlum, Mathias. “Nuclear Waste.” Energy Informative. 2013. http://energyinformative.org/nuclear-waste-reprocessing-recycling-disposal/ )

Would it be possible to recycle the nuclear waste we already have? **There is over 50.000 metric tons of spent nuclear fuel only in the U.S. and it’s piling up**. All the way back in the 1950’s people starting looking at the various options for dealing with this waste. Shooting it into space, deep-sea burial, burial in glaciers and all kinds of geological settings. The world’s best scientists are working to solve this waste problem by recycling/reprocessing nuclear waste. If successful, it could reduce the radioactive waste generated by nuclear power plants by 90%. When 5% of the uranium in the nuclear rods has been reacted, the entire fuel rod has been contaminated with plutonium and other fission products. The “spent” nuclear fuel rods are no longer efficient at making electricity, so it is treated as waste. Recycling nuclear waste is basically extracting the usable elements for energy production. The goal of these technologies is to efficiently close the nuclear fuel cycle. There are several problems that come with reprocessing/recycling nuclear waste, most importantly the costs and the debate if these methods actually are beneficial for the environment or not. U.S. does not currently allow reprocessing of nuclear waste. Nuclear power may produce no green house gases, but the nuclear waste it leaves behind, remaining radioactive for as long as 100.000 years, does possess a terrible problem for both people and the environment.\\\

#### Nuclear waste disposal causes extensive harms.

Kurkreja 16

(Kukreja, Rinkesh. “Nuclear Waste Disposal.” Conserve Energy Future. 2016 <http://www.conserve-energy-future.com/dangers-and-effects-of-nuclear-waste-disposal.php> )

1. Long Half Life: The products of nuclear fission have long half lives, which means that they will continue to be radioactive – and therefore hazardous- for many thousands of years. This means that, if anything were to happen to the waste cylinders in which nuclear waste is stored, this material can be extremely volatile and dangerous for many years to come. Since hazardous nuclear waste is often not sent off to special locations to be stored, this means that it is relatively easy to find, and if anyone with ill intent were to look for nuclear waste to serve unpleasant purposes, they may well be able to find some and use it. 2. Storage: Another problem with nuclear waste disposal that is still being discussed today is the issue of storage. Many different storage methods have been discussed throughout history, with very few being implemented because of the problematic nature of storing such hazardous material that will remain radioactive for thousands of years. Amongst the suggestions that were considered as above ground storage, ejection into space, ocean disposal and disposal into ice sheets. Of these, only one was implemented – ocean disposal was actually used by thirteen different countries and was the method of dumping radioactive waste into the oceans in order to get rid of it. Understandably, this practice is no longer implemented. 3. Affects on Nature: One of the biggest concerns that the world has with the disposal of nuclear waste is the affect the hazardous materials could have on animals and plant life. Although most of the time the waste is well sealed inside huge drums of steel and concrete, sometimes accidents can happen and leaks can occur. Nuclear waste can have drastically bad effects on life, causing cancerous growths, for instance, or causing genetic problems for many generations of animal and plants. Not disposing of nuclear waste properly can therefore have huge environmental impacts that can harm many millions of animals and hundreds of animal species.

### Solves Warming

#### Reprocessing nuclear fuel is extremely beneficial to the environment.

Hansen et al ’15 [Hansen, James; Emanuel, Kerry; Caldeira, Ken; Wigley, Tom; “Nuclear Power Paves The Only Visible Path Forward On Climate Change;” (December 3rd, 2015); The Guardian, Climate and Nuclear Scientist; (August 10th, 2016); https://www.theguardian.com/environment/2015/dec/03/nuclear-power-paves-the-only-viable-path-forward-on-climate-change - JS]

Everyone agrees that the most urgent component of decarbonisation is a move towards clean energy, and clean electricity in particular. We need affordable, abundant clean energy, but **there is no particular reason why we should favour renewable energy over other forms of abundant energy.** Indeed, cutting down forests for bioenergy and damming rivers for hydropower – both commonly counted as renewable energy sources – can have terrible environmental consequences. **Nuclear power,** particularly next-generation nuclear power with a closed fuel cycle (**where spent fuel is reprocessed**)**, is** uniquely scalable, and **environmentally advantageous.** Over the past 50 years, **nuclear power stations** – by offsetting fossil fuel combustion – **have avoided the emission of an estimated 60bn tonnes of carbon dioxide.** Nuclear energy can power whole civilisations, and produce waste streams that are trivial compared to the waste produced by fossil fuel combustion. There are technical means to dispose of this small amount of waste safely. However, nuclear does pose unique safety and proliferation concerns that must be addressed with strong and binding international standards and safeguards. **Most importantly for climate, nuclear produces no CO2 during power generation.** To solve the climate problem, policy must be based on facts and not on prejudice. **The climate system cares about greenhouse gas emissions – not about whether energy comes from renewable power or abundant nuclear power**. Some have argued that it is feasible to meet all of our energy needs with renewables. **The 100% renewable scenarios** downplay or ignore the intermittency issue by making unrealistic technical assumptions, and **can contain high levels of biomass** and hydroelectric power **at the expense of true sustainability.** Large amounts of nuclear power would make it much easier for solar and wind to close the energy gap.

### Solves Coal Shift

#### Nuclear power plants save the lives that would have been lost due to natural gas or coal.

Schrope 13

(Schrope, Mark. “Nuclear Plants Prevents More Deaths Than it Causes.” Chemical and Engineering News; American Chemical Societ. 2013. <http://cen.acs.org/articles/91/web/2013/04/Nuclear-Power-Prevents-Deaths-Causes.html> )

Using nuclear power in place of fossil-fuel energy sources, such as coal, has prevented some 1.8 million air pollution-related deaths globally and could save millions of more lives in coming decades, concludes a study. The researchers also find that nuclear energy prevents emissions of huge quantities of greenhouse gases. These estimates help make the case that policymakers should continue to rely on and expand nuclear power in place of fossil fuels to mitigate climate change, the authors say (Environ. Sci. Technol., DOI:10.1021/es3051197). In the wake of the 2011 Fukushima nuclear disaster in Japan, critics of nuclear power have questioned how heavily the world should rely on the energy source, due to possible risks it poses to the environment and human health. “I was very disturbed by all the negative and in many cases unfounded hysteria regarding nuclear power after the Fukushima accident,” says report coauthor [Pushker A. Kharecha](http://www.giss.nasa.gov/staff/pkharecha.html), a climate scientist at NASA’s Goddard Institute for Space Studies, in New York. Working with Goddard’s James E. Hansen, Kharecha set out to explore the benefits of nuclear power. The pair specifically wanted to look at nuclear power’s advantages over fossil fuels in terms of reducing air pollution and greenhouse gas emissions. Kharecha was surprised to find no broad studies on preventable deaths that could be attributed to nuclear power’s pollution savings. But he did find data from a 2007 study on the average number of deaths per unit of energy generated with fossil fuels and nuclear power (Lancet, DOI:10.1016/S0140-6736(07)61253-7). These estimates include deaths related to all aspects of each energy source from mining the necessary natural resources to power generation. For example, the data took into account chronic bronchitis among coal miners and air pollution-related conditions among the public, including lung cancer. The NASA researchers combined this information with historical energy generation data to estimate how many deaths would have been caused if fossil-fuel burning was used instead of nuclear power generation from 1971 to 2009. They similarly estimated that the use of nuclear power over that time only caused 5,000 or so deaths, such as cancer deaths from radiation fallout and worker accidents. Comparing those two estimates, Kharecha and Hansen came up with the 1.8 million figure. They next estimated the total number of deaths that could be prevented through nuclear power over the next four decades using available estimates of future nuclear use. Replacing all forecasted nuclear power use until 2050 with natural gas would cause an additional 420,000 deaths, whereas swapping it with coal, which produces significantly more pollution than gas, would mean about 7 million additional deaths. The study focused strictly on deaths, not long-term health issues that might shorten lives, and the authors did not attempt to estimate potential deaths tied to climate change. Finally the pair compared carbon emissions from nuclear power to fossil fuel sources. They calculated that if coal or natural gas power had replaced nuclear energy from 1971 to 2009, the equivalent of an additional 64 gigatons of carbon would have reached the atmosphere. Looking forward, switching out nuclear for coal or natural gas power would lead to the release of 80 to 240 gigatons of additional carbon by 2050. By comparison, previous climate studies suggest that the total allowable emissions between now and 2050 are about 500 gigatons of carbon. This level of emissions would keep atmospheric CO2concentrations around 350 ppm, which would avoid detrimental warming.

### Solves Econ

#### Reprocessing nuclear waste saves an exorbitant amount of money annually.

Berry and Tolley 10

(Professors R. Stephen Berry and George S. Tolley. “Nuclear Fuel Reprocessing: Future Prospects and Viability.” 2010. <http://franke.uchicago.edu/bigproblems/Team7-1210.pdf> )

**Reprocessing decreases the amount of nuclear waste that needs to be stored**, so the main benefit of reprocessing is the amount of storage saved from reprocessing fuel. Bunn estimated that overall repository costs are decreased by around 50% with reprocessing; repository costs of $400/kgHM for the nuclear fuel cycle will only be $200/kgHM for reprocessed high-level waste. A reprocessing facility with 900 tHM/yr capacity will therefore save $180 million in annual disposal costs. In total, over $35,407 million has been paid into the national Nuclear Waste Fund up until November 2010.90 Uranium prices have also been rising due to increased demand, a trend that may have long-term repercussions. Identified uranium deposits can fuel existing nuclear plants for about 80 years without reprocessing. Reprocessing can extend the life of current uranium resources for an additional 15 to 20 years.91 Total conventional uranium resources, including undiscovered deposits that are estimated using indirect geological evidence and extrapolated values, can fuel existing plants for around 200 years.92 In the short-term, however, prices have risen sharply because of an announced increase in nuclear plants that will require fuel: China is intending to increase nuclear power as a source of national energy by 7% in the next ten years, and countries such as Russia, Pakistan, and South Korea are all building new reactors.93 Another benefit of reprocessing is the additional plutonium and uranium recovered per kilogram of spent fuel reprocessed; this amount replaces a portion of the raw material that goes into the fuel cycle. The amount of recovered uranium is .94 kg/kgHM, and the amount of recovered plutonium is .01014 kg/kgHM.9 There are two benefits to this replacement: the fuel cycle inputs less new raw uranium, and the uranium produced from the reprocessing is already enriched. To calculate the reduction in raw uranium costs, we used the following values: a 900 tHM/year reprocessing capacity, 0.94 kg enriched U/kgHM, $60/ton of raw U, and a 14% conversion from raw to enriched uranium. These calculations are all referenced earlier in the section; our calculations showed that a reprocessing facility at this capacity would save the fuel cycle $362,571/year from less purchases of raw uranium. This calculation also demonstrated that the 846 tons of enriched uranium that the reprocessing facility produces annually would initially have had to come from 6,043 tons of raw uranium if produced in the once-through cycle. We use this value to calculate the saved enrichment costs; the conversion ratio we use in the once-through fuel cycle is .9686 SWU/kg of raw uranium. With an average enrichment of uranium cost of $123/SWU (an average of the costs in the table above), we calculate that reprocessing yields a savings from enrichment of approximately $720 million/year.

## Seabed Disposal

#### Countries should designate sub-seabed disposal as the sole candidate for its permanent nuclear waste repository.

#### Solves waste disposal

Wilson 14 [Wilson, founder of BuildingGreen, Inc. and executive editor of Environmental Building News, founded the Resilient Design Institute Alex, "Safe Storage of Nuclear Waste", Green Building Advisor, [www.greenbuildingadvisor.com/blogs/dept/energy-solutions/safe-storage-nuclear-waste SP](http://www.greenbuildingadvisor.com/blogs/dept/energy-solutions/safe-storage-nuclear-waste)//emchen)]

The big question now is how long it will be until the plant can be decommissioned and what to do with the large quantities of radioactive waste that are being stored onsite. Terrorism risks with nuclear power My concern with nuclear power has always been more about terrorism than accidents during operation or storage. I continue to worry that terrorists could gain entry to nuclear plant operations and sabotage plants from the inside — disabling cooling systems and causing a meltdown. There is also a remote risk of unanticipated natural disasters causing meltdowns or radiation release, as we saw so vividly with the Fukushima Power Plant catastrophe in Japan in March, 2011. For more than 30 years, the nuclear industry in the U.S. and nuclear regulators have been going down the wrong path with waste storage — seeking a repository where waste could be buried deep in a mountain. Nevada’s Yucca Mountain was the place of choice until… it wasn’t. Any time we choose to put highly dangerous waste in someone’s backyard, it’s bound to cause a lot of controversy, even in a sparsely populated, pro-resource-extraction place like Nevada. NIMBY opposition can be boosted by people in powerful places, and in the case of Yucca Mountain, Nevada senator Harry Reid has played such a role. (He has been the Senate Majority Leader since 2006 and served prior to that as the Minority Leader and Democratic Whip.) Aside from NIMBYism, the problem with burying nuclear waste in a mountain (like Yucca Mountain) or salt caverns (like New Mexico’s Carlsbad Caverns — an earlier option that was pursued for a while in the 1970s) is that the maximum safety is provided at Day One, and the margin of safety drops continually from there. The safety of such storage sites could be compromised over time due to seismic activity (Nevada ranks fourth among the most seismically active states), volcanism (the Yucca Mountain ridge is comprised mostly of volcanic tuff, emitted from past volcanic activity), erosion, migrating aquifers, and other natural geologic actions. A better storage option I believe a much better solution for long-term storage of high-level radioactive waste is to bury it deep under the seabed in a region free of seismic activity where sediment is being deposited and the seafloor getting thicker. In such a site, the level of protection would increase, rather than decrease, over time. In some areas of seabed, more than a centimeter of sediment is being deposited annually. Compacted over time, such sediment deposition could be several feet in a hundred years, and in the geologic time span over which radioactive waste is hazardous, hundreds to thousands of feet of protective sedimentary rock would be formed. The oil and gas industry — for better or worse — knows a lot about drilling deep holes beneath a mile or two of ocean. I suspect that the deep-sea drilling industry would love such a growth opportunity to move into seabed waste storage, and I believe the Nuclear Regulatory Commission or other agencies could do a good job regulating such work. The waste could be placed in wells extending thousands of feet below the seabed in sedimentary rock in geologically stable regions. Let's say a 3,000-foot well is drilled beneath the seabed two miles beneath the surface of the ocean. Waste could be inserted into that well to a depth of 1,000 feet, and the rest of the well capped with 2,000 feet of concrete or some other material. Hundreds of these deep-storage wells could be filled and capped, and such a sub-seabed storage field could be designated as forever off-limits. Industry or the Department of Energy would have to figure out how to package such waste for safe handling at sea, since the material is so dangerous, but I believe that is a surmountable challenge. For example, perhaps the radioactive waste could be vitrified (incorporated into molten glass-like material) to reduce leaching potential into seawater should an accident occur at sea, and that waste could be tagged with radio-frequency emitters so that any lost containers could be recovered with robotic submarines in the event of such accidents. While I’m not an expert in any of this, I’ve looked at how much money taxpayers and industry have already poured into Yucca Mountain — about $15 billion by the time the Obama Administration terminated federal funding for it in 2010, according to Bloomberg News — and the estimates for how much more it would take to get a working waste storage facility of that sort operational had risen to about $96 billion by 2008, according to the U.S. Department of Energy at the time. I believe that sub-seabed storage would be far less expensive.

### 2NR – CP Solves

#### Solves the aff ssd is able to isolate any radioactive nuclear waste from humans. Bala 2014

Amal Bala, Sub-Seabed Burial of Nuclear Waste: If the Disposal Method Could Succeed Technically, Could It Also Succeed Legally?, 41 B.C. Envtl. Aff. L. Rev. 455 (2014),SP

In general, two related methods of underwater disposal of SNF exist: dumping containers of radioactive waste into the ocean, and sub-seabed disposal. 92 The purpose of underwater disposal of SNF is the same as any other type of SNF disposal, which is to isolate radioactive waste from human contact and the environment long enough for any release of radiation to become harmless.93 The potential advantages of certain types of underwater SNF disposal for the United States could include effective containment of the waste and avoiding the controversy of a land-based national repository, such as the failed project at Yucca Mountain. 94 Underwater disposal of SNF, specifically subseabed disposal, could occur far from the coast of any state or nation and could thereby avoid the NIMBY (“not in my backyard”) syndrome, but this result is not guaranteed considering existing laws and a popular belief that Earth’s oceans are a global commons

## Energy Leadership PIC

### 1NC PIC

#### Counterplan Text: The United States Federal Government ought to prohibit production of nuclear power with the exception of traveling wave technology reactors and small modular reactors.

#### SMR’s and TWTR’s are vital to stop Chinese energy leadership

Palley 12— Reece Palley - author of many books and articles, including The Answer: Why Only Mini Nuclear Power Plants Can Save the World. The London School of Economics 1949-52 and The School for Social Research 1945-49; January 20, 2012 (“U.S. cedes the lead on nuclear energy”, Available Online at http://articles.philly.com/2012-01-20/news/30647588\_1\_nuclear-reactors-nuclear-energy-nuclear-waste)

Recent news that Gates has been meeting with the Chinese about traveling wave technology is particularly ominous. This could help put China at the forefront of a new industry and leave the United States, in nuclear terms, a banana republic.

The Chinese lack the contentious, partisan political structure that prevents some alternative technologies from growing in the United States. One is reminded of Mao's injunction to "let a hundred flowers blossom," which is still the Chinese government's attitude toward technological innovation. With this approach, and no need to contend with uninformed public opinion or political bickering, China threatens to rapidly outpace America in developing tomorrow's means of energy production.

In the 1980s, I went to China to help build factories for the manufacture of fiberglass luxury yachts. The Chinese started from absolute scratch, never having even seen a fiberglass yacht, yet in relatively short order, they were exporting million-dollar boats. If they start applying this kind of innovative energy to the construction and export of small, modular nuclear reactors, the world will cease to look to America for energy solutions. The Chinese, standing on the shoulders of half a century of American ingenuity, will inherit the leadership of the world's most vital industry.

#### Green leadership solves extinction – tech spills over and reduces geopolitical confrontation

Klarevas 11 –Louis Klarevas, Professor for Center for Global Affairs @ New York University, May 25, 2011, ("Securing American Primacy While Tackling Climate Change: Toward a National Strategy of Greengemony," http://www.huffingtonpost.com/louis-klarevas/securing-american-primacy\_b\_393223.html)IG

By not addressing climate change more aggressively and creatively, the United States is squandering an opportunity to secure its global primacy for the next few generations to come. To do this, though, the U.S. must rely on innovation to help the world escape the coming environmental meltdown. Developing the key technologies that will save the planet from global warming will allow the U.S. to outmaneuver potential great power rivals seeking to replace it as the international system’s hegemon. But the greening of American strategy must occur soon.

The U.S., however, seems to be stuck in time, unable to move beyond oil-centric geo-politics in any meaningful way.

Often, the gridlock is portrayed as a partisan difference, with Republicans resisting action and Democrats pleading for action.

This, though, is an unfair characterization as there are numerous proactive Republicans and quite a few reticent Democrats.

The real divide is instead one between realists and liberals.

Students of realpolitik, which still heavily guides American foreign policy, largely discount environmental issues as they are not seen as advancing national interests in a way that generates relative power advantages vis-à-vis the other major powers in the system: Russia, China, Japan, India, and the European Union.

Liberals, on the other hand, have recognized that global warming might very well become the greatest challenge ever faced by mankind. As such, their thinking often eschews narrowly defined national interests for the greater global good. This, though, ruffles elected officials whose sworn obligation is, above all, to protect and promote American national interests.

What both sides need to understand is that by becoming a lean, mean, green fighting machine, the U.S. can actually bring together liberals and realists to advance a collective interest which benefits every nation, while at the same time, securing America’s global primacy well into the future.

To do so, the U.S. must re-invent itself as not just your traditional hegemon, but as history’s first ever green hegemon.

Hegemons are countries that dominate the international system - bailing out other countries in times of global crisis, establishing and maintaining the most important international institutions, and covering the costs that result from free-riding and cheating global obligations. Since 1945, that role has been the purview of the United States.

Immediately after World War II, Europe and Asia laid in ruin, the global economy required resuscitation, the countries of the free world needed security guarantees, and the entire system longed for a multilateral forum where global concerns could be addressed. The U.S., emerging the least scathed by the systemic crisis of fascism’s rise, stepped up to the challenge and established the postwar (and current) liberal order.

But don’t let the world “liberal” fool you. While many nations benefited from America’s new-found hegemony, the U.S. was driven largely by “realist” selfish national interests. The liberal order first and foremost benefited the U.S.

With the U.S. becoming bogged down in places like Afghanistan and Iraq, running a record national debt, and failing to shore up the dollar, the future of American hegemony now seems to be facing a serious contest: potential rivals - acting like sharks smelling blood in the water - wish to challenge the U.S. on a variety of fronts. This has led numerous commentators to forecast the U.S.’s imminent fall from grace.

Not all hope is lost however.

With the impending systemic crisis of global warming on the horizon, the U.S. again finds itself in a position to address a transnational problem in a way that will benefit both the international community collectively and the U.S. selfishly.

The current problem is two-fold. First, the competition for oil is fueling animosities between the major powers. The geopolitics of oil has already emboldened Russia in its ‘near abroad’ and China in far-off places like Africa and Latin America. As oil is a limited natural resource, a nasty zero-sum contest could be looming on the horizon for the U.S. and its major power rivals - a contest which threatens American primacy and global stability.

Second, converting fossil fuels like oil to run national economies is producing irreversible harm in the form of carbon dioxide emissions. So long as the global economy remains oil-dependent, greenhouse gases will continue to rise. Experts are predicting as much as a 60% increase in carbon dioxide emissions in the next twenty-five years. That likely means more devastating water shortages, droughts, forest fires, floods, and storms.

In other words, if global competition for access to energy resources does not undermine international security, global warming will. And in either case, oil will be a culprit for the instability.

Oil arguably has been the most precious energy resource of the last half-century. But “black gold” is so 20th century. The key resource for this century will be green gold - clean, environmentally-friendly energy like wind, solar, and hydrogen power. Climate change leaves no alternative. And the sooner we realize this, the better off we will be.

What Washington must do in order to avoid the traps of petropolitics is to convert the U.S. into the world’s first-ever green hegemon.

For starters, the federal government must drastically increase investment in energy and environmental research and development (E&E R&D). This will require a serious sacrifice, committing upwards of $40 billion annually to E&E R&D - a far cry from the few billion dollars currently being spent.

By promoting a new national project, the U.S. could develop new technologies that will assure it does not drown in a pool of oil. Some solutions are already well known, such as raising fuel standards for automobiles; improving public transportation networks; and expanding nuclear and wind power sources. Others, however, have not progressed much beyond the drawing board: batteries that can store massive amounts of solar (and possibly even wind) power; efficient and cost-effective photovoltaic cells, crop-fuels, and hydrogen-based fuels; and even fusion.

Such innovations will not only provide alternatives to oil, they will also give the U.S. an edge in the global competition for hegemony. If the U.S. is able to produce technologies that allow modern, globalized societies to escape the oil trap, those nations will eventually have no choice but to adopt such technologies. And this will give the U.S. a tremendous economic boom, while simultaneously providing it with means of leverage that can be employed to keep potential foes in check.

#### SMRs solve case – they’re cheaper, easier and faster to make, more resistant to prolif, meltdowns, and waste mismanagement

Iyer et al 14 - Gokul Iyer, Nathan Hultman, and Steve Fetter of the School of Public Policy, University of Maryland, Son H. Kim of the Joint Global Change Research Institute, Pacific Northwest National Laboratory and University of Maryland: 6 July 2014 (“Implications of small modular reactors for climate change mitigation” Elseiver Ltd. Journal of Energy Economics, p. 1, Available Online at http://www.karnteknik.se/upload/aktiviteter/medlemsaktiviteter/20151009\_Staffan%20Qvists%20Energy%20Policy.pdf, Accessed 8/8/16)IG

Achieving climate policy targets will require large-scale deployment of low-carbon energy technologies, includ- ing nuclear power. The small modular reactor (SMR) is viewed as a possible solution to the problems of energy security as well as climate change. In this paper, we use an integrated assessment model (IAM) to investigate the evolution of a global energy portfolio with SMRs under a stringent climate policy. Technology selection in the model is based on costs; we use results from previous expert elicitation studies of SMR costs. We find that the costs of achieving a 2 °C target are lower with SMRs than without. The costs are higher when large reactors do not compete for market share compared to a world in which they can compete freely. When both SMRs and large reactors compete for market share, reduction in mitigation cost is achieved only under advanced assump- tions about SMR technology costs and future cost improvements. While the availability of SMRs could lower mit- igation costs by a moderate amount, actual realization of these benefits would depend on the rapid up-scaling of SMRs in the near term. Such rapid deployment could be limited by several social, institutional and behavioral obstacles. 1. Introduction The international community has established a target of keeping global mean temperature rise below 2 °C in order to prevent dan- gerous anthropogenic interference with the climate system (UNFCCC, 2010). Achieving such stringent climate goals will require substantial reductions—in the order of 50% below current levels— in the emissions of greenhouse gases(GHG) by 2050 and deeper cuts beyond (IPCC, 2007). Nuclear energy, along with other low-carbon technologies, is expected to play a significant role in contributing to the growing demand for energy without emitting CO2 (IAEA, 2013; Kim and Edmonds, 2007). However, perspectives vary widely on the potential for substantial increases in the deployment of nuclear power— a divergence that hinges on expectations of future cost reductions, risk of accident, proliferation dangers, waste dis- posal solutions and public acceptance of conventional nuclear power (see for example, Dittmar, 2012; Joskow and Parsons, 2012). In this context, there has been considerable interest in small modular reactors (SMRs) which are defined by the Internation- al Atomic Energy Agency (IAEA) as reactors whose sizes are smaller than 300 MWe (IAEA, 2012). Proponents view these reactors as more likely to overcome many of the problems faced by the nuclear industry today, with improved economics, proliferation resistance, and easier integra- tion into energy systems. They promise to provide an improved ap- proach to the dual problems of energy security and climate change, especially in the developing world. However, like any new technology, SMRs face a number of challenges for successful commercial de- ployment. Current cost estimates are highly uncertain because of the early stage of development, and the evolution of SMRs in the overall portfolio—competing with not only conventional nuclear but also all other energy sources—is therefore hard to estimate without a systematic method. In this paper, we investigate the implications of the availability of SMRs as a technology alternative for climate change mitigation. To do so, we add a new technology category of SMRs to an integrated assess- ment model (described in Section 3.1), and use cost estimates from the recent expert elicitation published by Abdulla et al. (2013). Then, we seek to answer the following questions: How much would the availabil- ity of SMRs impact the costs of achieving a stringent climate policy tar- get? How would these impacts change if there is no new investment in large reactors? 2. Background 2.1. Technical and economic advantages of the SMR option Three major types of SMR designs are being developed (see Vujić et al., 2012; Kessides and Kuznetsov, 2012; WNA, 2013a for comprehen- sive reviews of SMR designs). The first type is based on the pressurized water reactor (PWR) technology, which is in widespread use today in large reactors. Examples include the International Reactor Innovative and Secure (IRIS), which involves an international team coordinated by Westinghouse; the Russian KLT-40 and VBER-300; the NuScale 45 MWe; the Babcock and Wilcox 180 MWe mPower and the Westing- house 225 MWe (Carelli et al., 2004; IAEA, 2012; NuScale, 2013; Vujić et al., 2012; Westinghouse, 2013). In addition to the PWR concept, some SMR designs are also based on the boiling water reactor and heavy water reactor concepts (IAEA, 2012). The second type consists of high temperature gas-cooled reactors (HTGRs) that use helium gas as the coolant and graphite as moderator. The outlet temperature of the secondary fluid in these reactors is typically very high, which makes these reactors useful for cogeneration applications. Examples in- clude the ANTARES developed by AREVA, the Chinese Shidaowan pro- ject and the Gas Turbine Modular Helium Reactor (GT-MHR) by General Atomics (WNA, 2013a, 2013b). The third group includes SMRs that are cooled by liquid metal or molten salt. An example is the Toshiba 50 MWe S4 sodium-cooled fast reactor. The latter design con- cepts are expected to be the most difficult to license, since there is not much experience in operating such reactors or available test facilities for verifying new designs (Vujić et al., 2012). From an economic standpoint, the smaller size of the SMR means a potential loss of economies of scale in generation associated with large re- actors, but promises future economies of scale in manufacture and de- ployment. Recent expert elicitations have reported higher overnight (capital) costs for SMRs compared to GW-scale Gen II and Gen III systems (Abdulla et al., 2013; Anadon et al., 2012; Anadón et al., 2013).

Neverthe- less, SMRs have a number of technical and economic advantages com- pared to large reactors (Carelli et al., 2010; Ingersoll, 2009; Kessides and Kuznetsov, 2012; Kuznetsov, 2008; Rosner and Goldberg, 2011). First, un- like large reactors, SMR designs are compact because a number of compo- nents such as steam generators, pressurizer and reactor coolant pumps are integrated within the reactor vessel itself rather than outside of the re- actor. Most SMR designs incorporate passive safety features1 that reduce or eliminate the risk of fuel damage and radiation releases related to loss of coolant or loss of coolant flow. In addition, other features of the SMR such as a larger surface-to-volume ratio and reduced core power density facilitate easier removal of heat and the use of advanced passive features (Bae et al., 2001; Carelli et al., 2004; IAEA, 2009). SMRs also have a smaller fuel inventory which reduces the maximum possible release during an adverse event (Kessides, 2012). Second, because of their smaller sizes, SMRs would require reduced construction times and therefore smaller interest payments during con- struction (Abdulla et al., 2013). In other words, SMRs are likely to be fi- nancially less risky compared to large reactors. Third, the modularity of SMRs permits scaling the power plant to larger sizes based on incre- mental needs for energy and compatibility with the electrical grid infra- structure. Modularity offers other benefits not only by reducing the front-end investment and facilitating initial deployment but also en- hancing temporal and spatial flexibility in investment. The latter feature is an important distinction from large reactors because it creates an op- tion value: under uncertainty in future electricity prices, investment in large reactors is very risky as a large portion of the investment is sunk and irreversible. On the other hand, in spite of higher overnight costs, the modularity feature of SMRs offers a better control over market risk to investors (as investment can be split more easily to match market de- mand) and so the risk premium is lower (Gollier et al., 2005). Finally, SMRs can be mass produced in a factory and shipped to the site. Mass production could facilitate and accelerate cost reductions due to learning. Empirical evidence on cost reductions due to increasing capacity in the nuclear industry is mixed. In the past, several scholars found evidence of learning and experience spillovers leading to a lower- ing of costs in the nuclear industry (Lester and McCabe, 1993; Zimmerman, 1982). On the other hand, other scholars argued that in- creased construction times due to increased size and complexity of re- actors coupled with new environmental, health and safety regulations led to escalating capital as well as operating and maintenance costs (Cantor and Hewlett, 1988; Hewlett, 1996; Joskow and Rose, 1985). Similar findings have been reported by more recent studies that empha- size that the site-specific nature of deployment makes standardization difficult, so cost reductions have not been achieved and are not likely in the future (Cooper, 2010; Grübler, 2010; Hultman and Koomey, 2007; Hultman et al., 2007). However, in the case of SMRs, several scholars argue that cost savings can be achieved through off-site fabrica- tion of modules (which facilitates standardization), as well as learning- by-doing through the production of multiple, simple modules with shorter construction times (Abdulla et al., 2013; Kessides, 2012; Rosner and Goldberg, 2011). In addition, Rangel and Lévêque (2012) used detailed data for French reactors and argued that while overall ex- perience did not translate into lower costs, some gains were achieved due to the construction of standard reactor types. This finding is rele- vant to SMRs, which are likely to be co-sited and the same type of reac- tors are likely to be produced in larger numbers (Abdulla et al., 2013; Carelli et al., 2010). In the subsequent section, we discuss some of the policy rationales put forth by SMR proponents for promoting the de- ployment of SMRs. 2.2. Policy rationales for promoting SMRs Scholars have put forth a number of rationales for promoting SMRs. One important rationale for promoting nuclear energy in general and SMRs in particular is improving energy security. Access to energy sources depends on a complex system of global markets, vast cross-border infra- structure networks, a small group of primary energy suppliers, and inter- dependencies with financial markets and technology. Industrialized as well as developing nations have shown renewed focus on energy security because of the exceedingly tight oil market, high oil prices, instability in some exporting nations and geopolitical rivalries (Chester, 2010; Yergin, 2006). Nuclear power has been relatively unaffected by disruption in commodity markets. Natural uranium represents a very small fraction of the price of nuclear electricity, and uranium resources are spread throughout politically stable regions; the largest producers and exporters are Canada and Australia (IAEA, 2013). SMR proponents argue that be- cause of their small size and inherent safety features, SMRs could be sited in areas with small electric grids or in remote locations with little or no grid access, thereby accessing a wider range of markets than is pos- sible with traditional reactor technology (Kessides and Kuznetsov, 2012; Kuznetsov, 2008). Another rationale cited for encouraging the deployment of SMRs is to make use of the “early mover advantage” (Kim and Chang, 2012; SEAB, 2012). SMRs are relatively new entrants in the energy markets and promoting SMRs could improve the positioning and competitive- ness of domestic industries in the global value chain and also create em- ployment opportunities. For example, Denmark became a world leader in wind energy by mastering the commercialization process (Lund, 2009). This not only improved the international competitiveness of the industry but also compensated for the welfare loss in the infant pe- riod (Hansen et al., 2003).

#### Solves the whole case:

#### SMR’s are substantially smaller, they’re also underground which checks your surface waste arguments.

#### Competition checks your safety objections- SMR’s are the newest competition to big plants which encourages both to get better under capitalism- that competition didn’t *exist before these recent developments especially since your evidence assumes SMR’s don’t exist.*

### TWTR PIC

#### Counterplan Text: The United States Federal Government ought to prohibit production of nuclear power with the exception of traveling wave technology reactors and small modular reactors.

#### SMR’s and TWTR’s are vital to stop Chinese energy leadership

Palley 12— Reece Palley - author of many books and articles, including The Answer: Why Only Mini Nuclear Power Plants Can Save the World. The London School of Economics 1949-52 and The School for Social Research 1945-49; January 20, 2012 (“U.S. cedes the lead on nuclear energy”, Available Online at http://articles.philly.com/2012-01-20/news/30647588\_1\_nuclear-reactors-nuclear-energy-nuclear-waste)

Recent news that Gates has been meeting with the Chinese about traveling wave technology is particularly ominous. This could help put China at the forefront of a new industry and leave the United States, in nuclear terms, a banana republic.

The Chinese lack the contentious, partisan political structure that prevents some alternative technologies from growing in the United States. One is reminded of Mao's injunction to "let a hundred flowers blossom," which is still the Chinese government's attitude toward technological innovation. With this approach, and no need to contend with uninformed public opinion or political bickering, China threatens to rapidly outpace America in developing tomorrow's means of energy production.

In the 1980s, I went to China to help build factories for the manufacture of fiberglass luxury yachts. The Chinese started from absolute scratch, never having even seen a fiberglass yacht, yet in relatively short order, they were exporting million-dollar boats. If they start applying this kind of innovative energy to the construction and export of small, modular nuclear reactors, the world will cease to look to America for energy solutions. The Chinese, standing on the shoulders of half a century of American ingenuity, will inherit the leadership of the world's most vital industry.

#### Green leadership solves extinction – tech spills over and reduces geopolitical confrontation

Klarevas 11 –Louis Klarevas, Professor for Center for Global Affairs @ New York University, May 25, 2011, ("Securing American Primacy While Tackling Climate Change: Toward a National Strategy of Greengemony," http://www.huffingtonpost.com/louis-klarevas/securing-american-primacy\_b\_393223.html)IG

By not addressing climate change more aggressively and creatively, the United States is squandering an opportunity to secure its global primacy for the next few generations to come. To do this, though, the U.S. must rely on innovation to help the world escape the coming environmental meltdown. Developing the key technologies that will save the planet from global warming will allow the U.S. to outmaneuver potential great power rivals seeking to replace it as the international system’s hegemon. But the greening of American strategy must occur soon.

The U.S., however, seems to be stuck in time, unable to move beyond oil-centric geo-politics in any meaningful way.

Often, the gridlock is portrayed as a partisan difference, with Republicans resisting action and Democrats pleading for action.

This, though, is an unfair characterization as there are numerous proactive Republicans and quite a few reticent Democrats.

The real divide is instead one between realists and liberals.

Students of realpolitik, which still heavily guides American foreign policy, largely discount environmental issues as they are not seen as advancing national interests in a way that generates relative power advantages vis-à-vis the other major powers in the system: Russia, China, Japan, India, and the European Union.

Liberals, on the other hand, have recognized that global warming might very well become the greatest challenge ever faced by mankind. As such, their thinking often eschews narrowly defined national interests for the greater global good. This, though, ruffles elected officials whose sworn obligation is, above all, to protect and promote American national interests.

What both sides need to understand is that by becoming a lean, mean, green fighting machine, the U.S. can actually bring together liberals and realists to advance a collective interest which benefits every nation, while at the same time, securing America’s global primacy well into the future.

To do so, the U.S. must re-invent itself as not just your traditional hegemon, but as history’s first ever green hegemon.

Hegemons are countries that dominate the international system - bailing out other countries in times of global crisis, establishing and maintaining the most important international institutions, and covering the costs that result from free-riding and cheating global obligations. Since 1945, that role has been the purview of the United States.

Immediately after World War II, Europe and Asia laid in ruin, the global economy required resuscitation, the countries of the free world needed security guarantees, and the entire system longed for a multilateral forum where global concerns could be addressed. The U.S., emerging the least scathed by the systemic crisis of fascism’s rise, stepped up to the challenge and established the postwar (and current) liberal order.

But don’t let the world “liberal” fool you. While many nations benefited from America’s new-found hegemony, the U.S. was driven largely by “realist” selfish national interests. The liberal order first and foremost benefited the U.S.

With the U.S. becoming bogged down in places like Afghanistan and Iraq, running a record national debt, and failing to shore up the dollar, the future of American hegemony now seems to be facing a serious contest: potential rivals - acting like sharks smelling blood in the water - wish to challenge the U.S. on a variety of fronts. This has led numerous commentators to forecast the U.S.’s imminent fall from grace.

Not all hope is lost however.

With the impending systemic crisis of global warming on the horizon, the U.S. again finds itself in a position to address a transnational problem in a way that will benefit both the international community collectively and the U.S. selfishly.

The current problem is two-fold. First, the competition for oil is fueling animosities between the major powers. The geopolitics of oil has already emboldened Russia in its ‘near abroad’ and China in far-off places like Africa and Latin America. As oil is a limited natural resource, a nasty zero-sum contest could be looming on the horizon for the U.S. and its major power rivals - a contest which threatens American primacy and global stability.

Second, converting fossil fuels like oil to run national economies is producing irreversible harm in the form of carbon dioxide emissions. So long as the global economy remains oil-dependent, greenhouse gases will continue to rise. Experts are predicting as much as a 60% increase in carbon dioxide emissions in the next twenty-five years. That likely means more devastating water shortages, droughts, forest fires, floods, and storms.

In other words, if global competition for access to energy resources does not undermine international security, global warming will. And in either case, oil will be a culprit for the instability.

Oil arguably has been the most precious energy resource of the last half-century. But “black gold” is so 20th century. The key resource for this century will be green gold - clean, environmentally-friendly energy like wind, solar, and hydrogen power. Climate change leaves no alternative. And the sooner we realize this, the better off we will be.

What Washington must do in order to avoid the traps of petropolitics is to convert the U.S. into the world’s first-ever green hegemon.

For starters, the federal government must drastically increase investment in energy and environmental research and development (E&E R&D). This will require a serious sacrifice, committing upwards of $40 billion annually to E&E R&D - a far cry from the few billion dollars currently being spent.

By promoting a new national project, the U.S. could develop new technologies that will assure it does not drown in a pool of oil. Some solutions are already well known, such as raising fuel standards for automobiles; improving public transportation networks; and expanding nuclear and wind power sources. Others, however, have not progressed much beyond the drawing board: batteries that can store massive amounts of solar (and possibly even wind) power; efficient and cost-effective photovoltaic cells, crop-fuels, and hydrogen-based fuels; and even fusion.

Such innovations will not only provide alternatives to oil, they will also give the U.S. an edge in the global competition for hegemony. If the U.S. is able to produce technologies that allow modern, globalized societies to escape the oil trap, those nations will eventually have no choice but to adopt such technologies. And this will give the U.S. a tremendous economic boom, while simultaneously providing it with means of leverage that can be employed to keep potential foes in check.

## Immediate Dismantling CP

### 1NC CP

#### CP: Immediate dismantling works best-efficacy and future generations.

IEA 15

"Technology Roadmap: Nuclear Energy." IEA Technology Roadmaps (n.d.): n. pag. 2015. Web. 8 Aug. 2016. //VP

Increasingly, utilities are choosing the immediate dismantling option, to benefit from the knowledge of the plant’s operating staff, as well as to limit the burden borne by future generations.

#### Tech innovation k2 improve existing decommissioning processes

IEA 15

"Technology Roadmap: Nuclear Energy." IEA Technology Roadmaps (n.d.): n. pag. 2015. Web. 8 Aug. 2016. //VP

Although technologies and processes for decommissioning an NPP exist today, further technological developments and process improvements can help accelerate future decommissioning activities and reduce costs. For example (E.ON, 2014): z improve standardisation in the design z improve automation z develop more flexible remote controlled tools z develop tools to measure decontamination during the processes z improve techniques for decontamination.

### 1NC Spec Stuff

#### Decommissioning processes are a key element of the nuclear power debate-the public doesn’t know about it, so discussion of the issue is key to raise awareness. Learning about decommissioning {Could be theory card-must spec process of decommissioning reactors}

IEA 15

"Technology Roadmap: Nuclear Energy." IEA Technology Roadmaps (n.d.): n. pag. 2015. Web. 8 Aug. 2016. This card is fuckin fire //VP

Decommissioning will become **an increasingly important part of the nuclear sector activity** in the coming decades, as dozens of reactors will be shut down. **Industry must provide further evidence that it can dismantle these plants safely and cost effectively.** Further improvements in technology (for instance, robotics) and adaptation of regulations (for instance, allowing the clearance of nonradioactive material from a power plant as ordinary or municipal waste) can help to reach these objectives. It is **important** that decommissioning activities are **covered by sufficient funds**, and **governments have a responsibilit**y to ensure that this financial security is in place. In most countries, operators are required to **set aside dedicated funds**, the costs of which are internalised in the cost of nuclear electricity. Once a nuclear facility is closed permanently, whether it is for technical, economic or political reasons, it needs to be put into a state where it can do no harm to the public, workers or the environment. This includes removal of all radioactive materials, decontamination and dismantling, and finally demolition and site clearance. This process, **known as decommissioning**, consists of several stages that can take place over many years. The general public is often not well informed about decommissioning activities, and the ill-founded belief that decommissioning of nuclear facilities is an unsolved issue is one of the factors that can explain poor public acceptance of nuclear power. This Roadmap recognises that decommissioning is a significant challenge given the size of the fleet that will be retired in the coming decades. However, it is also a great opportunity for new business and skills to be developed. Demonstrating that NPPs that have been shut down can be dismantled safely and in a financially controlled manner is a key factor for allowing new build projects to move ahead. Today, decommissioning is a well-regulated activity of the nuclear fuel cycle, with specific safety guides and standards (e.g. IAEA, Western European Nuclear Regulators Association [WENRA]). As of December 2014, 150 power reactors had been permanently shut down and were in various stages of decommissioning. International information exchange forums exist, where processes are reviewed, lessons learnt and best practices shared. But it is also an area of technological expertise where operators and new industries compete (see Box 10).

#### Two main methods of decommissioning-can’t just dump the waste/appliances somewhere

IEA 15

"Technology Roadmap: Nuclear Energy." IEA Technology Roadmaps (n.d.): n. pag. 2015. Web. 8 Aug. 2016. //VP

There are essentially two main strategies for decommissioning: (i) immediate dismantling, where after the nuclear facility closes, equipment, structures, and radioactive materials are removed or decontaminated to a level that permits release of the property and termination of the operating licence within a period of about 10 to 15 years; (ii) deferred dismantling, where a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay – typically for about 30-40 years, after which the plant is dismantled and the property decontaminated. A third strategy exists called entombment, where all or part of the facility is encased in a structurally long-lived material. It is not a recommended option, although it may be a solution under exceptional circumstances (such as after a severe accident).

## Phase Out CP

### 1NC – Generic

#### CP Text: All aff actors should phase out nuclear power over the coming decades. Mutually exclusive with the aff because they defend immediate implementation

### 1NC – Germany

#### Germany’s policy demonstrates that phase out can work

Glaser 12 [Alexander Glaser, associate professor at the Woodrow Wilson School of Public and International Affairs and the Department of Mechanical and Aerospace Engineering at Princeton University, “From Brokdorf to Fukushima: The long journey to nuclear phase-out,” Bulletin of the Atomic Scientists, 2012] JW

Shortly after the accident at the Fukushima Daiichi Nuclear Power Station, Germany’s government started preparing legislation that would close the country’s last nuclear power plant by 2022. But this wasn’t an entirely new development: Germany had been planning to leave nuclear energy behind for decades, and to understand its nuclear phase-out requires a close look at the past. Several projects and events mark the beginnings of the German anti-nuclear power movement: Among them are the huge protests over the Brokdorf reactor, which began in 1976 and led to civil war-like confrontations with police, and the controversy over the Kalkar fastneutron reactor in the mid-1970s. Because of these and subsequent developments-including the 1986 Chernobyl accident-by the 1990s, no one in German political life seriously entertained the idea of new reactor construction. This tacit policy consensus led to energy forecasts and scenarios that focused on energy efficiency, demand reduction, and renewable energy sources. By the time of the Fukushima accidents, many of these new energy priorities had already begun to be implemented and to show effect. Replacing nuclear power in Germany with other energy sources on an accelerated schedule is likely to come with a price tag, but, at the same time, Germany’s nuclear phase-out could provide a proof-of-concept, demonstrating the political and technical feasibility of abandoning a controversial high-risk technology. Germany’s nuclear phase-out, successful or not, may well become a game changer for nuclear energy worldwide.

### Energy Gap

#### Energy gap from nuclear phase out can be compensated for over several years

Resch et al 14 [Gustav Resch, senior researcher in the area of energy policy and energy modelling at Energy Economics Group, “Phase out of Nuclear Power in Europe – From Vision to Reality,” GLOBAL 2000, March 2014] JW

\*brackets from original text

The energy [r]evolution Advanced scenario which forms the basis for our overall assessment takes a nuclear power phase-out until 2035 for the EU into account. This scenario projects an electricity generation of 78 TWh from nuclear power plants for the year 2030, what equates to 8.6% of nuclear generation in 2011 or 2.2% of total generation for the year 2030 (Eurostat, 2013c; Teske et al., 2012a, 125). The simple answer to the overarching question whether or not the supply gap that would arise in the case of an earlier nuclear phase out (i.e. by 2030 instead of 2035) can be compensated is “Yes” – according to our brief complementary assessment it appears feasible to compensate this gap. The recommended option to do so is to build on additional energy savings / efficiency measures, and as part of that we advocate to reduce the demand for hydrogen that serves as fuel for other sectors (i.e. transport and industrial processes). More precisely, the alternative renewable electricity (RES-E) supply scenario, assessed with the Green-X model, combined with the fossil electricity sector as envisioned in the energy [r]evolution and a nuclear power phase-out trajectory five years prior to the energy [r]evolution, is presented in Figure A-1.

### Employment

#### Phasing out nuclear energy would help employment

Resch et al 14 [Gustav Resch, senior researcher in the area of energy policy and energy modelling at Energy Economics Group, “Phase out of Nuclear Power in Europe – From Vision to Reality,” GLOBAL 2000, March 2014] JW

Employment in nuclear energy Employment in nuclear energy grows by 9% in the Reference scenario between 2015 and 2030, while generation falls by 14%. In the energy [r]evolution Advanced scenario generation is reduced by 90% between 2015 and 2030, representing a virtual phase out of nuclear power. Employment in the energy [r]evolution Advanced increases by 35% from 2015 to 2030. This is because the accelerated closure of nuclear plants results in a significant increase in nuclear decommissioning employment. It is expected these jobs will persist for 20 - 30 years. (Teske et al., 2012a, 75) 4.4.2 Employment effects according to the Employ-RES study The impacts on economy and employment through RES and increasing energy efficiency measures in 2020 are significant. Improving current policies to achieve the 20% RES by 2020 target will provide a net effect of about 410,000 additional jobs and 0.24% additional gross domestic product (GDP). These are the key-results of the Employ-RES study, which was conducted by a consortium of EU research institutions led by Fraunhofer ISI on behalf of the European Commission’s DirectorateGeneral Energy and Transport and finalised in 2009. (Ragwitz et al., 2009)

## Mining CP

### Mission 2016 CP

#### Counterplan text: An international non governmental group ought to implement uranium mining regulations modeled after Mission 2016 plan of green mining. To clarify, the government will be shutting down illegal and unregulated mines, cleaning the sites of shut down mines, and increase research and development of green uranium mining technology.

**MIT is the solvency advocate** Massachusetts Institute of Technology. *Using Environmentally Conscious Mining Standards*. Mission 2016: The Future of Strategic Natural Resources. Post-2012

New mining technologies and regulations have *significantly* improved *mining efficiency and reduced environmental impact in recent years. In general, mining techniques become much more environmentally sensitive when efficiency is improved because less waste is produced.* However, even greater improvements must be made as part of Mission 2016's plan. *The* current "green" mining techniques need to become more widespread *and there will be a focus on researching new environmentally friendly techniques.* The plan *for improving efficiency and decreasing the environmental impact of mining is broken up into the following categories:* Shut[s] *ting* downillegal and unregulated mines*/ Choosing environmentally friendly general mining processe*s/ Implement[s] *ing recently discovered* green mining technologies/ Clean[s] *ing up* the sites of shut-down mines*/ Reevaluating Cut-off Grades/ Research and Development of Green Mining Technology The plan below is described with respect to REEs in order to illustrate a specific example. However,* many of the same problems are inherent in mining of other strategic elements, and thus Mission 2016's solutions can be applied and implemented for these mines as well.

#### Advantage 1 is Jobs

**MIT continues** Massachusetts Institute of Technology. *Using Environmentally Conscious Mining Standards*. Mission 2016: The Future of Strategic Natural Resources. Post-2012

Many areas that used to have mines are now contaminated*.* People live in these areas, despite the fact that the water and soil may have high concentrations of unsafe chemicals and heavy metals such as lead. R2 technology is a process that subjects mine wastes to physical and chemical processes that recover the metals while improving the condition of the land (Re-Use and Reprocess R2 Technologies, 2009). Mission 2016 suggests that an international non-governmental environmental group concerned with mine clean-up and implementing green mining technology will be started and funded by governments, private donations, proceeds from reclaimed materials, and mining companies. Mining companies will have interest in this group because it will provide a rating for mines. This rating system will be analogous to the way the US eating establishments are rated for safety. Mines will be rated based on how minimal their environmental impacts are*.* The environmental group will lobby governments to give tax breaks to mines with especially high ratings. This group will also fund the use of R^2 technology to clean-up toxic areas. It costs approximately 3.40 per yard USD of clean-up initially and then 0.40 USD per yard per year for the next thirty years (Re-Use and Reprocess (R2) Technologies, 2009). This will create jobs and improve the affected land. Any money made from the materials reclaimed in the cleanup process will be sold by the environmental group to make the group more self-sufficient. This will not have any adverse effects on the governments of the abandoned mines being cleaned as these mines will have already been shut down.

#### Advantage 2: Pollution

National Research Council Uranium Mining in Virginia: Scientific, Technical, Environmental, Human Health and Safety, and Regulatory Aspects of Uranium Mining and Processing in Virginia. Committee on Uranium Mining in Virginia; Committee on Earth Resources;

The committee did not conduct a risk assessment for uranium mining in Virginia because a detailed site-specific analysis is beyond the committee’s charge. The first step in assessing the risks associated with the release of contaminants from the uranium mine and mill would be to conduct a vulnerability analysis for security events and a risk analysis for natural disasters and other accidents. The consequences are not determined by the initiating event—they are determined by the design of the facility and whether the facility has appropriate spill prevention, containment, and countermeasures. The potential for long-term environmental effects requires a probabilistic risk assessment, driven in part by the inherent risks posed by the uranium mining, processing, and waste handling, but [are] mitigated by the pollution prevention measures. A comprehensive risk assessment, including accident and failure analyses, is an essential step in any site-specific permitting decision. On the basis of an examination of published studies, the committee concludes that best practices, if properly implemented in association with rigorous monitoring, should address or allow the site operator to take action to mitigate the majority of short-term environmental effects from routine uranium-specific mining and processing activities*.*

#### Studies prove nuclear power is very key to keeping nuclear energy under control. Doing the aff destroys this

Bryce 15 Robert Bryce. December 11, 2015. Bryce, Robert. "The Anti-Science, Anti-Nuclear Left." National Review, n.d. Web. 11 Aug. 2016.

In January of this year, the International Energy Agency declared that “nuclear power is a critical element in limiting greenhouse gas emissions.” It went on to say that global nuclear generation capacity must more than double by 2050 (to about 750 gigawatts) if the countries of the world are to have any hope of limiting temperature increases to the 2-degree scenario that is widely agreed upon as the acceptable limit. The scientists at the Intergovernmental Panel on Climate Change have made it clear that nuclear energy is essential. In its latest report, known as AR5, which was released last year, the IPCC declared that achieving deep cuts in greenhouse-gas emissions “will require more intensive use of low-GHG technologies such as renewables [and] nuclear energy.” In 2013, four of the world’s leading climate scientists issued an open letter that was clearly aimed at anti-nuclear groups like Greenpeace and Sierra Club. They said that renewable energy sources like wind and solar “cannot scale up fast enough to deliver cheap and reliable power at the scale the global economy requires.” The authors — former NASA climatologist James Hansen, Kerry Emanuel of MIT, Tom Wigley of the University of Adelaide in Australia, and Ken Caldeira of the Carnegie Institution — wrote an open letter  that “continued opposition to nuclear power threatens humanity’s ability to avoid dangerous climate change.” They continued: “There is no credible path to climate stabilization that does not include a substantial role for nuclear power.” They concluded by saying that if environmental activists have “real concern about risks from climate change,” they should begin “calling for the development and deployment of advanced nuclear energy.”

This is competitive because:

1. It is being implemented by an international non governmental group
2. It is about implementing uranium mining regulations, not prohibiting nuclear power production
3. Governmental judiciary is not capable, procedural oversight is necessary

Yellin, Joel. "High Technology and the Courts: Nuclear Power and the Need for Institutional Reform." *Harvard Law Review* 94.3 (1981): 489-560. Web.

Moreover, the nuclear power cases demonstrate that [requires] substantive oversight of complex [and] environmental decisions requires a level of technological sophistication not presently within the capacity of the judiciary. The alternative, purely [is] procedural oversight of the kind suggested by Judge Bazelon383 and widely practiced by the courts of appeals,384 inevitably gives agencies the incentive to move the focus of decision ever deeper into the technological and scientific realm in which their discretion is largely unquestioned,385 vitiating the usefulness of external oversight. Procedural techniques simply cannot directly influence the internal agency reasoning that is central to complex environmental decisionmaking.386 Rather, their role is to illuminate the issues for the courts, Congress, the Executive, and the public. I do not believe, however, that the possibilities for judicial review as a framework for meaningful oversight are barren. The intellectual traditions and political independence of the courts are virtues too valuable to ignore. And if meaningful oversight is to exist at all, the nuclear power cases suggest hybrid scientific and legal review is needed.387 That need may

## IFNEC CP

### 1NC – Generic

#### Text: Countries already or considering developing nuclear power should join the International Framework for Nuclear Energy Cooperation.

#### It creates networks for nuclear power without having to establish domestic facilities, educates countries on the safe and proper use of nuclear power—solves prolif and warming.

WNA 15 [World Nuclear Association; Information on nuclear energy and the nuclear fuel cycle; August 2015; “International Framework for Nuclear Energy Cooperation”; <http://www.world-nuclear.org/information-library/current-and-future-generation/international-framework-for-nuclear-energy-coopera.aspx>; JLB (8/8/2016)]

The International Framework for Nuclear Energy Cooperation (**IFNEC**), formerly the Global Nuclear Energy Partnership (GNEP), **aims to accelerate the development and deployment of** advanced **nuclear** fuel cycle **tech**nologies **while providing** greater **disincentives to the proliferation of nuclear weapons.** GNEP was initiated by the USA early in 2006, but picked up on concerns and proposals from the International Atomic Energy Agency (IAEA) and Russia. The vision was for a global network of nuclear fuel cycle facilities all under IAEA control or at least supervision. Domestically in the USA, the Global Nuclear Energy Partnership (GNEP) was based on the Advanced Fuel Cycle Initiative (AFCI), and while GNEP faltered with the advent of the Barack Obama administration in Washington from 2008, the AFCI was being funded at higher levels than before for R&D "on proliferation-resistant fuel cycles and waste reduction strategies." Two significant new elements in the strategy were new reprocessing technologies which separate all transuranic elements together (and not plutonium on its own), and advanced burner (fast) reactors to consume the result of this while generating power. However, this then disappeared from the US Department of Energy (DOE) budget. GNEP was set up as both a research and technology development initiative and an international policy initiative. **It addresses the questions of how to use sensitive tech**nologies **responsibly in a way that protects global security,** and also how to manage and recycle wastes more effectively and securely. The USA had a policy in place since 1977 which ruled out reprocessing used fuel, on non-proliferation grounds. Under GNEP/IFNEC, reprocessing is to be a means of avoiding proliferation, as well as addressing problems concerning high-level wastes. Accordingly, the DOE briefly set out to develop advanced fuel cycle technologies on a commercial scale. As more countries consider nuclear power, **it is important that they develop the infrastructure capabilities necessary** for such an undertaking. Forum (GIF) and the Multinational Design Evaluation Programme (MDEP).